Aalto University
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THE SPILLOVER EFFECT OF URBAN RENEWAL ON LOCAL HOUSING PRICES: CASE MYLLYPURO

Master's Thesis
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Abstract

In this paper, I empirically examine the spillover effects on local housing prices of an urban renewal program done in Myllypuro, a suburb in eastern Helsinki. I use the dismantling and construction of a new shopping center as the treatment in a differences-in-differences (DID) empirical study and compare the prices of apartments in old multistory buildings from 1960s and 1970s close to the shopping center in Myllypuro to apartments in two different areas. First, I compare prices near Myllypuro's shopping center to prices farther away from the shopping center around and inside Myllypuro, and second, to prices near similar shopping centers in other comparable neighborhoods.

I find that prices within 400 meters from the new shopping center in Myllypuro grew considerably faster, at 11 to 15 percent, compared to areas farther away from the center over a ten year period. In addition, the second model provides positive results. I find that apartment prices within 800 meters from Myllypuros's new shopping center grew considerably faster, at 4 to 16 percent, compared to the similar apartments in the same distance band from shopping centers in control neighborhoods of Kontula, Vuosaari, Itäkeskus and Mellunmäki also in eastern Helsinki over the same ten year period.

However, whether the increase in prices is due to the new shopping center is a trickier question. The results from comparing prices near the shopping center seem convincing and the common trends assumption seems plausible. On the other hand, the results from the neighborhood comparison should be considered as more descriptive than causal as the common trends are not as evident. Literature strongly suggest, that when there are positive spillover effects from urban revitalization programs or infill development meaning construction of new houses in undeveloped parcels, the effect is usually strongest near the development. Furthermore, in addition to the new shopping center, the amount of infill development has been considerably larger in Myllypuro compared to close-by neighborhoods. It can be concluded that the dismantling of the old building and construction of a new shopping center along with other urban renewal actions can be seen as driving forces in contributing to the superior growth rate in price in Myllypuro relative to neighborhoods that previously were comparable to it.

Keywords urban renewal, infill development, difference-in-differences, hedonic regression, spillover effects

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Tiivistelmä

Tässä tutkielmassa tutkitaan Myllypuron kaupunkiuudistuksen ulkoisvaikutuksia asuntojen hintoihin. Tarkastelun keskiössä on vanhan ostoskeskuksen purkaminen ja uuden rakentamisen vaikutukset lähellä sijaitsevien 1960- ja 1970-luvulla rakennettujen kerrostaloasuntojen hintoihin difference-in-differences –estimoinnin avulla. Empiirinen tarkastelu tehdään kahdella tavalla. Ensimmäisessä tarkastelussa vertaillaan ostoskeskuksen lähellä olevien asuntojen hintoja kauempana sijaitsevien asuntojen hintoihin. Toisessa tarkastelussa vertaillaan Myllypuron ostoskeskuksen lähellä olevien asuntojen hintoja lähellä sijaitsevien metron varrella olevien asuinalueiden asuntojen hintoihin.

Tuloksina voidaan tiivistää, että asuntojen hinnat 400 metrin sisällä Myllypuron ostoskeskuksesta ovat nousseet huomattavasti nopeammin verrattuna kauempana sijaitsevien asuntojen hintoihin vanhan ostoskeskuksen purkamisen aloittamisen jälkeen. Hinnat ovat nousseet 11 – 15 prosenttia verrokkiryhmää nopeammin purkamista seuranneen kymmenen vuoden aikana. Kun tarkastellaan Myllypuron asuntojen hintakehitystä verrattuna muihin idässä metron varrella sijaitsevien asuinalueiden Kontulan, Vuosaaren, Itäkeskuksen ja Mellunmäen hintoihin, voidaan todeta, että samalla etäisyydellä ostoskeskuksesta sijaitsevien asuntojen hinnat ovat nousseet selvästi nopeampaa vauhtia Myllypurossa verrokkiryhmiin verrattuna. Hinnat ovat nousseet 4 – 16 prosenttia verrokkiryhmää nopeammin purkamista seuranneen kymmenen vuoden aikana.

Onko uudella ostoskeskuksella ollut kausaalivaikutuksia vanhojen asuntojen hintoihin? Tutkielman tulokset osoittavat selvää vaikutusta ja ovat tilastollisesti merkitseviä. Samanlaisten asuntojen hintakehitys Myllypuron ympärillä ennen uuden ostoskeskuksen rakennusprojektin aloitusta vuonna 2009 ovat olleet samanlaisia. Vertaillessa asuinalueita keskenään kausaalivaikutusten löytäminen on kuitenkin hankalampaa. Tässä tapauksessa samanlainen hintakehitys ennen uuden ostoskeskuksen rakennusprojektin aloittamista ei ole yhtä selkeä kuin ensimmäisessä tarkastelussa. Löytämäni tulokset ovat kuitenkin samansuuntaisia alan kirjallisuuden kanssa. Uuden ostoskeskuksen lisäksi Myllypurossa on ollut selvästi enemmän täydennysrakentamista verrokkiryhmiin verrattuna, joka on osaltaan voinut lisätä positiivista hintakehitystä Myllypurossa. Yhteenvetona voidaan todeta, että uudella ostoskeskuksella ja muilla kaupunkiuudistustoimenpiteillä on ollut selvä vaikutus erilaisiin asuntojen hintakehityksiin muuten samanlaisilla asuinalueilla.

Avainsanat kaupunkiuudistus, täydennysrakentaminen, difference-in-differences, hedoninen regressio, ulkoisvaikutukset

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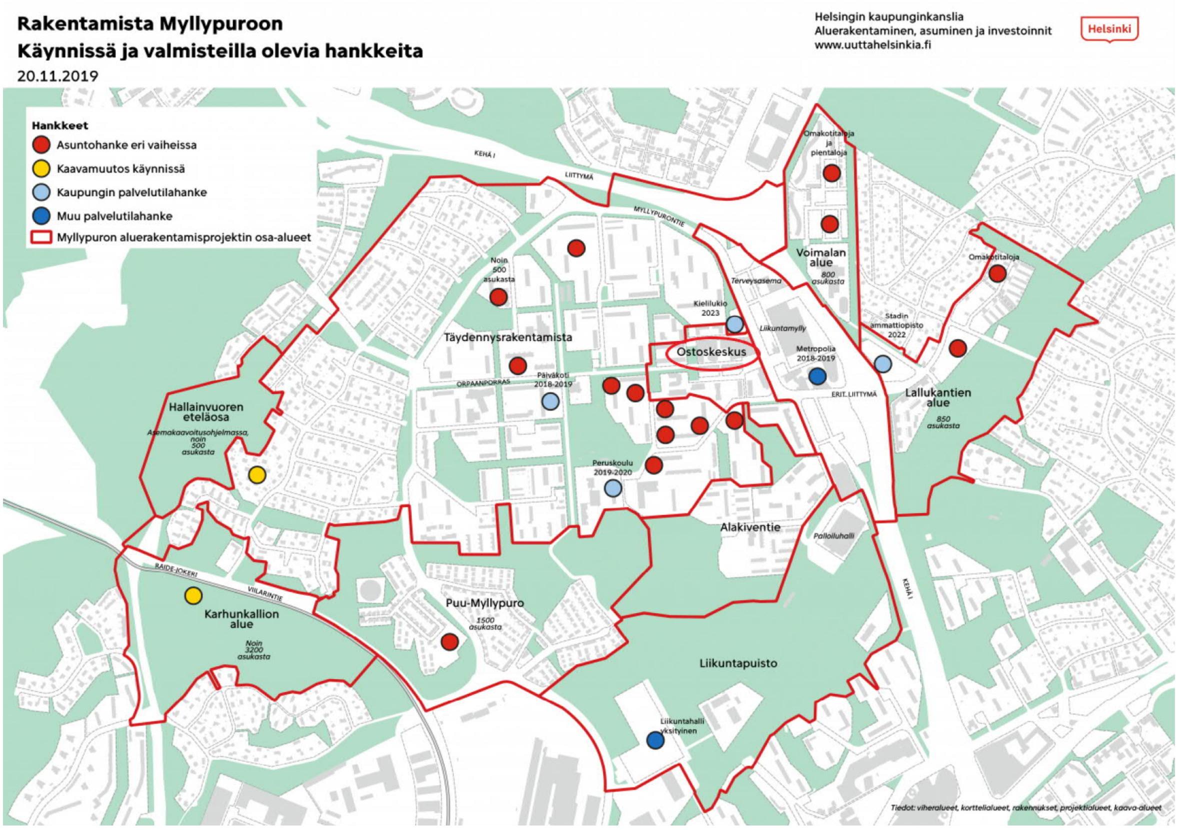
1 Introduction

Lately, Helsinki and the Helsinki Metropolitan Area (HMA) has been under a lot of construction and urban renewal as the population keeps on growing. In addition to the creation of completely new housing areas, the old suburbs (lähiöt) have been systematically renewed by the City of Helsinki under "The Neighborhood Project (lähiöprojekti)" to ensure that these places remain attractive neighborhoods to live in. In this thesis, I focus on empirically quantifying the spillover effects on prices of one of these projects done in Myllypuro. The Neighborhood Project in Myllypuro has included many different actions, for example, the construction of a new shopping center, the revamping of buildings and residental environments and the infill development of the area (Nuppunen et al, 2007). Especially the dismantling of the old shopping center and the building of a new one from 2009 to 2012 is in the core of studying the spillover effect of this urban renewal project. The first thoughts of renewing and possibly replacing the mall were formed already in 1999 and the city council approved the changed zone plan in 2004 after an architecture competition for designing the new mall area (Mäenpää, 2015). A map of Myllypuro showing the new shopping center, infill development and other urban renewal actions is displayed in figure 1

While the socioeconomic and descriptive aspect of The Neighborhood Project in Myllypuro has been studied, the magnitude of the causal effect on prices has not. Miettinen (2017) compered in her pro-gradu the house prices in Myllypuro to similar neighborhoods near metro stations in the east and found out that the houses prices in Myllypuro have been increasing more rapidly relative to the comparison neighborhoods. However, no comprehensive statistical approaches were used and the causal spillover effect of urban renewal on surrounding house prices remains a mystery.

The current literature on urban renewal and infill development does not have a clear implication on what the spillover effect could be. Infill development, which can be a part of an urban renewal project, and its spillover effects have been studied in the HMA by Ahvenniemi et al. (2018) and Kurvinen and Vihola (2016). While Ahvenniemi et al. (2018) do not find any statistically significant positive or negative effects of infill development on existing housing prices, Kurvinen and Vihola (2016) find that there are statistically significant positive effects of 2.3 -2.6 per cent on the prices of comparable housing units within a 300 meter radius of a new apartment building. Both of these studies focused on the HMA and on apartment units using a difference-in-differences approach with a hedonic pricing model. In the other studies focusing on infill

Figure 1: New shopping center, infill development and other ongoing renewal actions in Myllypuro in 2019.



Notes: Shopping center circled in red. Red dots indicate current infill development, light blue dots renewal actions by the municipality and dark blue dots other developments, for example, the new Metropolia Applied University campus situated on the right hand side of the shopping center. (City of Helsinki, 2019b)

development the effect can be either positive (Ooi and Le, 2013) or mixed (Zahirovich-herbert and Gibler, 2014). On the other hand, in the empirical studies focusing on urban renewal, the spillover effects found are mostly positive (Ahlfeldt et al., 2017; Rossi-hansberg et al., 2010). However, a large chunk of the empirical literature is done on studying affordable housing effects in the United States and while the older studies before 2010 show mainly positive effects, for example, (Schwartz et al., 2006; Ellen and Voicu, 2006; Ellen et al., 2001). The newer studies using more sophisticated empirical methods show mixed results, for example, (Diamond and McQuade, 2019; Funderburg and MacDonald, 2010). In the latter type of studies, the institutional setting is quite different and thus the implications to this study remain questionable.

In this thesis I study the causal effect of urban renewal on prices of apartments in old multistory buildings built in the 1960s and 1970s in one HMA Neighborhood, Myllypuro. The goal of this thesis is to better understand the basics of housing pricing mechanisms and how public policy projects, such as the neighborhood project, affect the pricing of the housing stock nearby. To provide a fresh approach to understanding the effects of urban renewal, in the empirical section of this thesis I study the spillover effect of dismantling and construction of a new shopping center along other urban renewal actions such as infill development. I use a difference-in-differences empirical strategy combined with a hedonic regression pricing model.

In this thesis I will empirically answer the following research question *"What is the spillover effect of an urban renewal project on local apartment prices in Myllypuro?"*. In summary, I find that the prices near the new shopping center have grown considerably faster, at 4 to 16 percent, relative to the control neighborhoods and areas over a ten year period. I study the spillover effect using two different approaches. First, I compare prices near the new shopping center to prices farther away within and around Myllypuro. Second, I compare different distance bands around Myllypuro's shopping center to comparable distance bands near shopping centers in control neighborhoods of Kontula, Vuosaari, Itäkeskus and Mellunmäki. While the first model seems to satisfy the common trends assumption, the results from the second model should be taken with a grain of salt.

The policy implications from this study can be of interest for various policy makers and consumers participating in the housing market. For a comparison, the market anticipation effect of the new metro line in Espoo has been studied in doctoral dissertation by Harjunen (2018) and he found the effect to be positive capitalization of 4 percent in housing prices within 800 meters from new metro stations. The results from this study suggest effects in the same direction. By carefully considering the newest information on the spillover effects of different urban renewal actions and infrastructure projects, policy makers can make better educated decisions on what to spend city funds on. Prices can be seen as powerful metrics in determining neighborhood quality.

2 Housing prices and urban renewal

This section reviews the literature needed to understand and define the empirical strategy presented in chapter five. To better understand the pricing implications, first a basic understanding of how houses are priced and what type of commodity they are is needed. This is done by reviewing the basic model of hedonic pricing first presented by Rosen (1974) and by discussing amenity and supply effect working channels.

Second, a literature review on the previous empirical literature is conducted to have some implication on what the spillover effect and its magnitude might be. This subsection is divided into four different components. First, urban renewal is defined and the empirical literature is discussed. Second, the spillover effect of infill development are discussed. Third, the empirical literature on affordable housing is discussed, and finally, literature on other type of urban development that can affect prices is discussed.

2.1 How houses are priced?

2.1.1 Dwelling characteristics and Hedonic Pricing

This section discusses the theory behind hedonic pricing and how the pricing of a house can be divided in to its dwelling characteristics. This is done mainly by discussing the hedonic model introduced by Rosen (1974).

Hedonic Pricing is a product differentiation model which assumes that these certain types of goods are valued for their "utility-bearing" characteristics and can be used as the regression model in the Difference-in-Differences empirical strategy discussed in the next section. In other words, one can determine the implicit prices of each characteristics in a given product (Rosen, 1974). For example, for otherwise similar houses, how much does the floor level of an apartment change the price. Important factors for housing prices can include, for example, structural (dwelling) characteristics, neighborhood and location characteristics.

Naturally, there can be variation in the estimated coefficients for certain housing characteristics depending on the location of the study and this has to be taken into account when reviewing the literature. Sirmans et al. (2006) studied how much different housing characteristics change over location in their meta-analysis for studies in the United states. They found out that, for example, area coefficient is sensitive to some geographical locations and the amount of variables in the hedonic model but no to household income, source of data or to time.

2.1.2 Amenity and supply channels

A good way to understand the spillover effect of urban development on nearby housing prices is to look at the working channels of pricing. Ooi and Le (2013) divide the spillover channels into two, the amenity and supply effect. In a nutshell, the amenity effect suggests that the prices of apartments should increase since urban development and especially infill development makes a given neighborhood a better and more attractive place to live in. Naturally, for the effect to be positive, it is required that the new infill development is better designed than the existing housing stock. The amenity effect can work in the other direction as well. Infill development can lead to congestion as the area becomes more crowded and to the loss of green areas.

On the other hand, if urban development includes infill development and thus increases in the housing stock, this could lead to a opposite effect of decreasing prices in the given neighborhood. This implications comes from the basic laws of demand and supply in a perfect competition setup. Naturally, the pricing of houses is a more complicated issue which cannot be fully understood with the most basic tools of microeconomics.

In theory the working channels can seem relatively simple. In the next section I discuss the empirical findings from the literature and the relations to the basic pricing theory.

2.2 Implications from the literature

In this section the current empirical literature is discussed in detail and I focus on four different types of empirical literature. First, I define what urban renewal is and what does the current empirical literature have to say about the spillover effect of urban renewal on housing prices nearby. Second, I discuss the spillover implications of infill development, which can be an important part of a urban renewal project. Third, I discuss the literature focusing on affordable housing. Fourth, I discuss how other types or development, for example, building of new sports stadium, can affect the nearby housing prices. Finally, I conclude the empiric literature and discuss what are the implications to the empirical work I am conducting in this thesis.

I came up with this division for the following reason. The empirical setting I am studying is a mix of urban renewal actions, infill development and there is subsidized money involved as well. By understanding the different elements involved in the pricing of housing and by reviewing the current empirical literature from different angles, I have a better chance of understanding the underlying spillover mechanisms studied in the empirical section of this thesis.

Some basic understanding is needed to understand the literature presented. Most of the studies cited use some modification of a difference-in-differences (DID) empirical strategy. The main intuition behind a DID strategy is relatively simple and now I will provide a context specific example. A DID is used to study the causal effects of a natural experiment when a randomized controlled trial is not feasible which is quite often the case in public policy projects. In a DID study, the key identifying assumptions are that both the treatment and control group would have evolved similar absent the treatment in other words the common trends assumption and that the treatment does not have spillovers to the control group (Angrist and Pischke, 2008).

It is easiest to understand a DID study by discussing a context specific example. Lets think about a two completely identical neighborhoods A and B: the housing stock, neighborhood amenities and distance to central business district are all similar in the neighborhoods A and B. Then the treatment happens, for example, a new shopping center is built in neighborhood A and we want to know what is the effect of this new shopping center on the prices of houses in neighborhood A. In a DID study we assume that the prices of these two neighborhoods would have evolved in a similar manner without the treatment i.e. the common trends assumption. Now if prices increased by 15 percent in neighborhood A and by 10 percent in neighborhood B, the difference-in-differences estimator is 5 percent assuming nothing else affecting prices happened in either neighborhood A or neighborhood B during the treatment period.

In many of the spillover effect studies, a popular way to form a control group is to assume that only prices near the development are affected and to create a ring that captures the treatment effect. For example, in the ring models treatment group can be every dwelling within a 500 meter radius around the development and the control group can be dwellings 500-1000 meters from the development. Some of the studies use arbitrary chosen rings (Ooi and Le, 2013), while other rely on more sophisticated methods for choosing the ring, for example, a continuous semiparametric way (Rossi-hansberg et al., 2010). The optimal ring can be chosen arbitrarily or by testing different distance bands and seeing the effect on price on each of these bands.

The traditional way to form a control group is to use similar neighborhood(s) as control groups (Ahvenniemi et al., 2018). For example, an effect of urban renewal project can be measured by comparing the prices in the treated group to one or multiple control groups. When using (a) different neighborhood(s) as a control group(s), the importance of the common trends assumption must be emphasized. In practise this means that the only treatment that is suppose to happen is the treatment affecting the treatment group and there are no other treatments to the control group(s).

Using a DID empirical strategy is always a double-edged sword. While it can be a powerful tool in capturing causal effects from natural experiments, it always relies on satisfying the key identifying assumptions discussed above. In a DID study, you will always get results. However the results only have causal implications and internal validity if the we believe the empirical strategy and key identifying assumptions presented. Every DID empirical study should include graphs showing the common trends between groups. In addition, yearly estimates can be a powerful tool in both showing the common trends and in determining the correct year when the treatment started. The latter requirement is especially important when it is not clear when the treatment starts i.e. when does the capitalization to housing prices happen in this context.

2.2.1 Urban renewal on housing prices

Urban renewal can be defined as actions that rehabilitate and improve the attractiveness of a given neighborhood. These actions can be, for example, the construction of new buildings, dismantling and/or renovating buildings or other renovation in the neighborhood in question. However, the term urban renewal is not the only word use to describe these rehabilitation actions. For example, Rossi-hansberg et al. (2010) use the term urban revitalization Also the terms redevelopment and place-based policy have been used to describe the same phenomena. In this thesis the term urban renewal is used to describe the actions of the Neighborhood Project in Myllypuro described in section 4.

Rossi-hansberg et al. (2010) found positive externalities studying a urban revitalization program in Virginia between 1999 and 2014. They found by using a semiparametric hedonic pricing model, that for every dollar invested in the revitalization program, land value gains were estimated to fall between \$2 and \$6 implying a good return on investment. Furthermore, the authors notice that despite the externalities being large, the effect falls by half every 1,000 feet. However, this paper mainly discusses the effects on land prices. The implications for multistory building might be different.

Ahlfeldt et al. (2017) found positive but partly statistically non-significant effects of a spatially targeted renewal policy in Berlin, Germany. They used the dismantling of the Berlin wall after the Cold War period as a basis for their quasi-experimental research design and found that the estimated effect on property prices to increase between 0.1 and 2% per year. However, their lower bound estimates were not statistically significant. Their back-of-the-envelope calculations results indicate a 0.06 - 1.35 euro increase in total property value for each euro spent on the program.

Not all of the empirical results indicate positive spillover effects of neighborhood renewal. Newell (2010) used a hedonic regression model and found decreasing values in nearby housing prices in North Carolina after housing investment in a Self Help project. However, in contrast to most of the literature, the author did not use a DID empirical strategy.

In table 1 I summarize the main results of empirical studies on urban renewal.

Table 1: Summary of urban renewal effects

Author(s) & Year	Study summary	Effect on	Empirical strategy	Spillover effect
Ahlfeldt et al. (2017)	Renewal policy. Berlin, Germany.	Property prices	DID & hedonic regression.	Partly positive spillover. 0.1%-2% annually.
Rossi-hansberg et al. (2010)	Urban Revitalization program. Virginia, United States	Land values	Semi-parametric hedonic regression.	Positive spillover. 2-5% annually.
Newell (2010)	Urban renewal. North Carolina, United States.	Property prices	Hedonic regression.	Negative Spillover.

2.2.2 Infill development on housing prices

The effects of infill development have been studied quite thoroughly both in Finland and abroad. Infill development can be defined as developing vacant areas in already existing neighborhoods and can be a part of an urban renewal project. In this section I discuss the literature that mainly focuses on just quantifying the effects of infill development. I start by discussing the empirical literature from Finland and then move on to discussing the empirical findings from abroad. Many of the infill development studies abroad are in the context of affordable housing and these studies are discussed in the following subsection.

In Finland, in the Helsinki Metropolitan Area, the empirical findings are quite scarce. The main two papers discussed here are by Kurvinen and Vihola (2016) and Ahvenniemi et al. (2018). The two studies differ both in their empirical strategies and in their results. While the former study found positive effects using a DID with a ring model, the latter found no significant positive nor negative effects using a zip code neighborhood comparison strategy.

Kurvinen and Vihola (2016) found positive impacts of residential development on nearby houses. In their study they used a matched sample and hedonic-based difference-in-differences study and found out that the construction of a new multi-story building increased the prices by 2.3-2.6 per cent of similar apartments within a 300 meter radius in the Helsinki Metropolitan Area. They focused on studying the price impact on houses built in the 1960s and 1970s. Which can be seen promising for this study.

However, the study by Kurvinen and Vihola (2016) does not seem to meet the standards of a rigorously studied DID study. The authors do not provide any evidence of how well the common trends assumption holds in their case. They do not provide any graphs but argue that the matched sample used in their empirical strategy should provide a good enough comparison point.

Ahvenniemi et al. (2018) do not find either statistically positive or negative effects of infill development on existing apartments. They used a difference-in-differences empirical strategy with a hedonic regression model and studied also the Helsinki Metropolitan Area by focusing on 7 different neighborhoods and buildings mainly built in the 1960s, 1970s and 1980s. The control neighborhoods were chosen individually for each treatment neighborhood and the authors acknowledge that choosing the treatment and control neighborhoods was done based on their own local knowledge. The authors provide a graph displaying the common trends for each of the case studied. This furthermore validates their results.

In a study focusing on a modern city in Singapore, Ooi and Le (2013) found positive and persistent effects of infill developments on local housing prices. In their study, they used a DID empirical strategy based on a hedonic pricing model and compared houses inside and outside a chosen 500 meter ring. They conclude that their evidence might indicate that the spillover effect can be traced to the overpricing of new homes by developers. They show that based on their model, the average overpricing of 4.8% indicates a 1.22% increase in prices of nearby homes.

In addition, Ooi and Le (2013) note that while the overall effect is positive, the scale of the development does not have a significant effect on the local housing prices and that there are negative externalities from the height of the new structure. Furthermore, they found that the effects of infill development on tear-down sites are significantly positive.

Ooi and Le (2013) have divided their model into two using different specifications for the control group. First, for their main results, they use a 500 meter radius as the treatment group for the infill development while the rest of the properties in the same planning area act as a control group. Second, for their robustness check, they use a 500-1000 meter radius from the infill development as control group. They find that the signs for their main variables of interest remain the same with both of the models.

Zahirovich-herbert and Gibler (2014) results indicate no overall significant effect on housing prices nearby. In their study, they use a hedonic regression model to estimate the premium paid for new houses and the effects of these houses on existing housing prices. Still, they find a small but significantly positive effect on surrounding houses when the new houses are considerably larger than the existing housing stock and find that the effect is strongest within one-quarter mile. However, the effect is negative when the newly built houses are similar compared to the existing houses, and thus are direct competitors in the same housing market.

Table 2 summarizes the empirical literature on infill development.

Table 2: Summary of infill development empirical studies

Author(s) & Year	Study summary	Effect on	Empirical strategy	Spillover effect
Ahvenniemi et al. (2018)	Multistory apartment building development. HMA, Finland.	Multistory building from 1960s to 1980s	DID with hedonic regression.	No significant spillover.
Kurvinen and Vihola (2016)	Multistory apartment building development. HMA, Finland	Multistory building from 1960s & 1970s	DID with hedonic regression. 300 meter ring.	Positive spillover. 2.3-2.6% immediately.
Zahirovich-herbert and Gibler (2014)	Infill development. Louisiana, United States.	Property prices	Hedonic regression.	Mixed spillover.
Ooi and Le (2013)	Infill development. Singapore	Property prices	DID with hedonic regression. 500 meter ring.	Positive spillover. 1.22%.

2.2.3 Affordable housing projects on housing prices

Large chunk of the empirical literature discusses the spillover effects of non market-based infill development meaning subsidized or affordable housing. These urban renewal programs studied can be seen as policy driven and they mainly focus on house or land prices not apartments in multistory buildings as is studied in this thesis. Nevertheless, I present briefly the most interesting studies in this study area.

Before discussing the empirical literature studying affordable housing, it is important to remember that there might be selection bias involved in policy driven renewal programs. Politicians have incentives to invest in programs that have the biggest potential for visible results. In addition, many of the studies reviewed here are not done by urban economists and are quite old.

Diamond and McQuade (2019) found the spillover effects of subsidized properties to be positive and increase house prices in the low-income neighborhoods and vice versa for the high income neighborhoods in the Unites States. By using and developing a nonparametrical DID empirical strategy with hedonic regression model, they found that this Low Income Housing Tax Credit (LIHTC) increased house prices by 6.5 per cent in the low income neighborhoods, lowered crime rates and attracted racially and income diverse populations. However, the price effect was opposite in the higher-income areas and prices decreased by 2.5 per cent and attracted lower-income households.

In another LIHTC - study, Funderburg and MacDonald (2010) found negative spillover effects of "siting a new low-rise, concentrated low-income LIHTC project", leads to 2 - 4 per cent slower growth in nearby houses. Furthermore, they conclude that these effects are persistent five or more years after the project is approved. They use matched pairs as control groups and use panel data between 1999 - 2007. As we can see the methods and results are quite different compared to the results by Diamond and McQuade (2019).

On the other hand, Funderburg and MacDonald (2010) study three mixed-income projects and three elderly type projects. While the effects for the latter are mainly positive, at 2 to 4 percent faster relative growth, the effect for the former are inconclusive.

Ellen and Voicu (2006) find that both nonprofit and for-profit projects have a positive and significant spillover effect on nearby houses. They used a DID empirical strategy with 1000 foot ring model when studying the effect of city-supported rehabilitation of rental housing in New York City. Furthermore, they conclude that the effect of small for-profit projects were greater compered to the nonprofit ones.

Schwartz et al. (2006) found positive external effects of subsidized housing investments to their neighborhood. They used a DID identification strategy with a hedonic regression model and a distance ring model and studied New York City's investment in new, subsidized housing and found the effect to be both significant and that the effects have been sustained over time. Their policy implication suggests that subsidized housing can be used to provide affordable housing and revitalize urban neighborhoods. However, they remind that the external validity of their result must be taken with a grain of salt due to the special nature of the New York City's housing market.

Also, Ellen et al. (2001) studied the subsidized construction in New York City and found positive spillover effects of subsidized construction of affordable owner-occupied homes on surrounding property values. Their empirical setting was similar to Schwartz et al. (2006) and by using a DID empirical strategy with a ring model they found a positive effect on the prices on nearby houses.

Nguyen (2005) reviews 17 papers on the spillover effects of affordable housing, and concludes that the effects are mixed and depends on a variety of factors such as the design of the affordable housing and the compatibility of the existing neighborhood and the concentration of affordable housing. 6 out of the 10 studies reviewed that used hedonic regression models showed positive spillover effects on the prices of nearby houses. However, the studies were from 1993 to 2001 and the implications can be questionable.

In table 3, I summarize the key studies on affordable housing.

Table 3: Summary of affordable housing empirical studies

Author(s) & Year	Study summary	Effect on	Empirical strategy	Spillover effect
Diamond and McQuade (2019)	LIHTC. United States	Property prices	Nonparametric DID with hedonic regression.	Mixed spillover. -2.5% to 6.5% (low income).
Funderburg and MacDonald (2010)	LIHTC. Iowa, United States	Single-family home values	Hedonic regression with Propensity matched controls.	Mixed, mainly negative spillover. -2- -4%
Schwartz et al. (2006)	Subsidized housing. NYC, United States	Property prices	DID with hedonic regression. 2000 feet ring.	Positive spillover.
Ellen and Voicu (2006)	Nonprofit Housing. NYC, United States	Property prices	DID with hedonic regression. 1,000 feet ring.	Positive spillover.
Nguyen (2005)	Affordable housing. United States.	Property prices	Literature review.	Mainly positive spillover.
Ellen et al. (2001)	Subsidized housing. NYC, United States.	Property Prices	DID with hedonic regression. Ring model.	Positive spillover.

2.2.4 Neighborhood amenities on housing prices

While the effect of a new shopping center has not been studied, other neighborhood amenities such as sport stadiums and new metro lines have been. Ahlfeldt and Kavetsos (2014) find positive external effects of building a new sport stadium on nearby property prices. They studied two stadium projects, used a DID identification strategy and estimated yearly estimations for the treatment as it is not always clear when the capitalization happens, is it when the stadium is announced, when the construction starts or finishes. Their results show a increase in total aggregate value of nearly 3 billion in areas near the stadiums compared with a loss of 1.4 billion from decrease in the value in property prices near the old stadium location. Can any conclusion be drawn from the construction of a Sport Stadium? I think there are similarities and this paper provides valuable insight on the neighborhoods amenities effect on the prices of surrounding. However, it has to be noted that the negative effects of infill development, for example, the supply effect is missing from this kind of study.

The capitalization effect from public transport development can be seen of interest here. Harjunen (2018) studied in his doctoral dissertation the capitalization effect on housing prices of the new western metro line in the HMA and found the effect to be around 4 percent within 800 meters from new metro stations. Furthermore, he finds that the effect starts swiftly after the construction begins.

2.3 Literature conclusion

The literature does not give clear implications for the empirical research I am doing for three main reasons. First, most of the studies focus on affordable housing development and the focus is mainly prices of single family houses in the United States, not on apartments in multistory buildings in urban neighborhoods. Second, the results of these studies are mixed. Finally, the quality of the empirical work done in these papers can be quite questionable. In addition, the literature on the causal effects of new shopping centers are quite non existent. In this subsection I will tackle all these aspects of the current literature one by one.

The literature has slightly positive implications from the most relevant literature reviewed. Out of the literature reviewed, only the Finnish ones (Ahvenniemi et al., 2018; Kurvinen and Vihola, 2016) and the Singaporean Ooi and Le (2013) focus strictly on apartments in multistory buildings in urban neighborhoods. While Kurvinen and Vihola (2016); Ooi and Le (2013) report positive results, Ahvenniemi et al. (2018) have statistically non-significant results. As discussed earlier, the study by Kurvinen and Vihola (2016) do not seem to meet the empirical standards required when using a DID empirical strategy.

However, most of the literature review is done on the spillover effects of affordable housing in the United States and therefore the implications can be tricky for three main reasons. First, the potential of selection bias is quite high in these studies. It is in the policy makers interest to choose areas that have the highest potential to grow and become a more desirable place. Second, the institutional setting can differ drastically. The affordable housing can mean construction through tax incentives, for example, (Diamond and McQuade, 2019; Funderburg and MacDonald, 2010) or through rental housing, for example, (Ellen and Voicu, 2006). The variation is quite high and therefore the implications can differ. Third, the United States' housing market is quite different and single family house are not the best proxy for the effect on apartments in multistory buildings.

To summarize the previous literature, they hint a positive spillover effect, but some the papers have contrary or statistically non significant effect. Out of the 14 empirical studies reviewed, 9 had either positive or mainly positive spillover results, 2 had mixed or statistically non significant results and two had negative results.

The quality of the empirical work can be quite questionable and does not meet the minimum requirement for the key identifying assumptions for DID work in many of the papers. Despite the fact that most of the papers (9/14) use DID identification strategy, only four of them present graphs as part of satisfying the common trends assumption which should be the first step when doing a DID study (Angrist and Pischke, 2008; Cunningham, 2018). Furthermore, showing common trends graphs is only the first step in satisfying the key identifying assumptions in a DID empirical study. A natural second step would be to show, for example, yearly coefficients for the treatment group to have a better understanding when the actual effect took place.

3 Institutional setting

In this section I discuss the institutional setting that created the natural experiment studied in this thesis. I do this by reviewing two contributing areas. First, I briefly discuss the HMA Housing market and why there is a need for more housing in the first place. Second, I discuss The Neighborhood and Urban project which can be seen as the driving force in the urban renewal actions done in Myllypuro. in addition, I discuss how the renewal in Myllypuro compares to the control groups.

3.1 HMA Housing market

The population in the HMA has been growing and this growth has been projected to keep on continuing. For the last five years, the population in Helsinki has been growing for an average of nearly 8000 persons per year. This growth has been faster compared to growth anytime after the 1960s (Vuori and Kaasila, 2019). Naturally, this leads to increase demand for housing in the area.

According to City of Helsinki (2019a), 54 000 apartments in multistory buildings has been built between 2003 and 2018 in Helsinki. This is an average of 3000 apartments per year and roughly one per cent compared to the whole multistory building apartment stock of 300 000 in Helsinki. In addition, the City of Helsinki stated in 2016 that the goal is to build 6000 dwellings per year (Karjalainen, 2016).

The City of Helsinki has stated in its City Plan vision 2050, that Helsinki of 2050 will comprise of ten large districts that feature their own services and resemble "small towns"(City of Helsinki, 2013). With this in mind, we can think of Myllypuro as one of their pilot projects.

In the literature review in section 3, I discussed how different types of urban renewal actions affect the prices of surrounding houses. In the beginning of this section I showed that there is need for more new housing in Helsinki as the population keeps on growing. In the next subsection, I discuss what has been done in Myllypuro before moving on to the empirical section of the thesis.

3.2 The Neighborhood project and the Urban project

In this subsection I discuss both City of Helsinki's The Neighborhood Project and partly EU funded Urban II projects. I start by discussing the common backgrounds for these projects and then move on to discussing how these projects affected Myllypuro specifically.

The City of Helsinki started The Neighborhood Project in 1996 and the project continued for 21 year until the end of 2017 (Helander and Ruotsalainen, 2017). The project was originally founded to ensure common paths for urban renewal in the chosen suburban neighborhoods. The Neighborhood project originally focused on four neighborhoods built in the 1960s and 1970s: Myllypuro, Vanha Vuosaari, Kontula and Pihlajisto (Pulkkinen and Idström, 2017). Out of the four mentioned neighborhoods, three former ones are considered as control group candidates in the empirical section of the thesis.

The European Union started urban regeneration program called the Urban 1 in 1994 to revitalize economically and socially problematic neighborhoods in the European countries. Urban II continued the program from 2001 to 2006. (Broman, 2007).

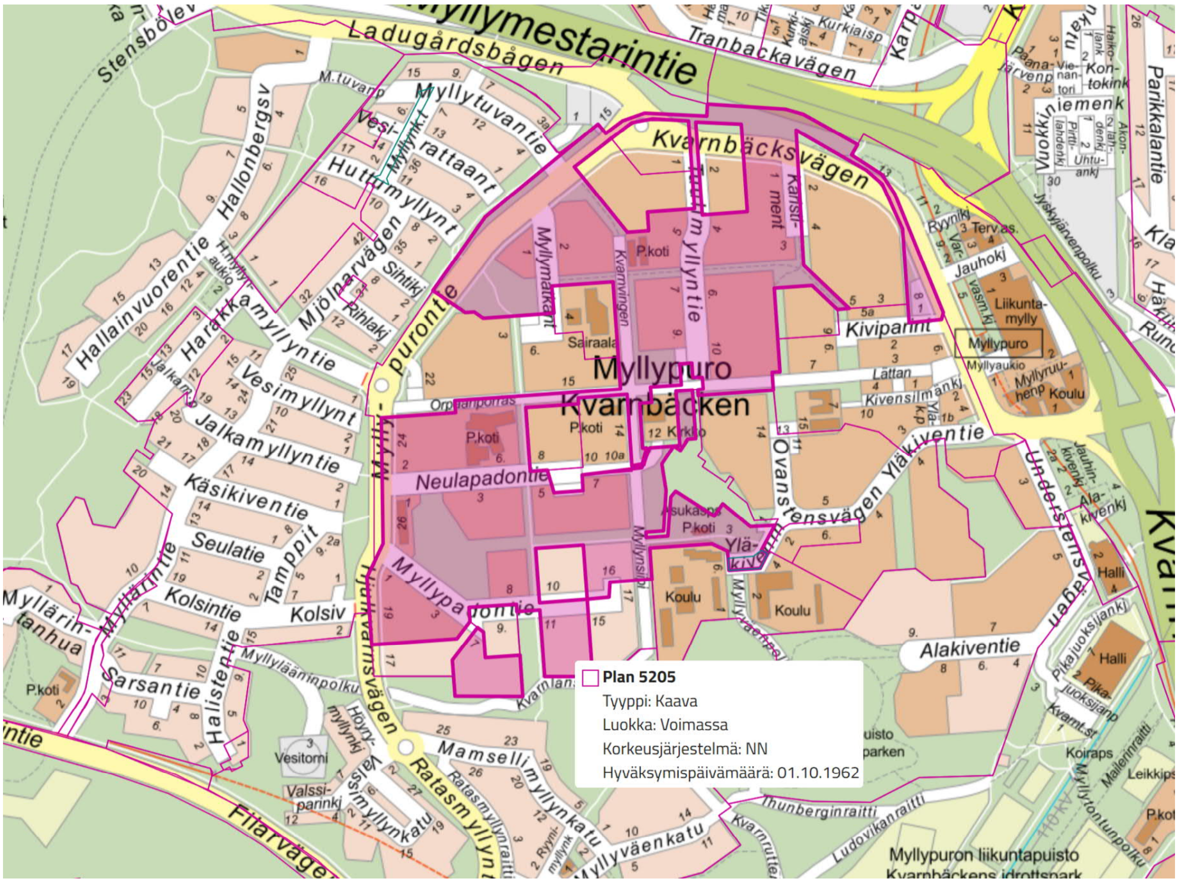
In the HMA, both Urban I and Urban II projects were carried out. In Helsinki, Myllypuro and Kontula neighborhoods were both part of Urban I and Urban II programs. The budget for the Urban II project in these two neighborhoods was 14.5 million euros and the costs were divided between the State, City of Helsinki, European Union and private investment. (Broman, 2007)

3.2.1 Case Myllypuro

The neighborhood of Myllypuro was originally developed in the 1960s and majority of the multistory buildings were built between 1964-1966. The old shopping center of Myllypuro was constructed at the same time in 1966. In the first three years 12 000 people moved into the brand new neighborhood. The development continued in the 1970s and new houses were built but the construction slowed down in the 1980s and 1990s. (Pulkkinen and Idström, 2017). In figure 2, in a city plan index map, the area of the old multistory buildings is highlighted.

As discussed earlier, the neighborhood project in Myllypuro started in 1996. In the first 10 years of the neighborhood project, 97% of the buildings restored their facades either fully or partly. During the same time period, 35 million was spend on renovation and 19 elevators were built with the aid of government subsidies. In addition, many improvement where made to improve the attractiveness of the area, for example, redesigning pedestrian paths, local green areas etc. (Pulkkinen and Idström, 2017).

Figure 2: Myllypuro City Plan Index 1962.



Notes: The multistory buildings of interest, built in the 1960s and 1970s, are situated in the map in the area highlighted with purple.

In the 2000s and 2010s, the biggest changes in Myllypuro have been infill development and the dismantling of the old shopping center and the construction of the new shopping center in the heart of Myllypuro. In the first decade of the 21st century, 58 000 square meters of dwelling floor space was constructed. In 2010 to 2015, the construction pace increased and 93 000 square meters of floor pace was constructed. Majority of these building have been infill development and new multistory buildings. In addition, row- and single family houses have been built in the new area called Puu-Myllypuro and in Alakakiventie. Around 40% of the dwelling are privately owned which is similar compared to the average in Helsinki (Pulkkinen and Idström, 2017).

These amounts of construction are considerably larger compared to nearby neighborhoods. When considering only apartments in multistory buildings. Between 2010 and 2018, over 759 new apartments were completed in Myllypuro compared to 80 in Itäkeskus and 248, 278 and 408 in Kontula, Mellunmäki and Keski-Vuosaari respectively (City of Helsinki, 2019a). The new dwelling stock in each of the areas can be seen in table 4.

Table 4: Dwelling stock of new Multistory buildings in 2018 (City of Helsinki, 2019a)

	2000 - 2009	2010 - 2018
Itäkeskus	149	6
Myllypuro	294	759
Kontula	164	278
Mellunmäki	258	248
Keski-Vuosaari	1301	408

One of the major drivers for the fast construction pace was the new shopping center built in the center of Myllypuro starting from 2009 and completed in 2012 (Mäenpää, 2015). The plans for the new shopping center were already accepted in 2004 when the city plan was approved by the Helsinki City Council.

In addition to the changes in the dwelling stock and attractiveness of the area, the campus of Metropolia University of Applied Sciences was built right by the metro station. The construction started in 2016 and is planned to be fully completed and operational by 2020 when the rest of campus area is taken into use.

In summary, Myllypuro has seen a lot of change in 21st century. The most visible changes have been the construction of the new shopping center, infill development and the building of the new Metropolia campus. This raises the question whether this has made Myllypuro a more attractive place to live? I aim to answer this question in the empirical section of this thesis by using a DID empirical strategy and focusing on prices of privately owned houses.

4 Data and Empirical Strategy

This chapter discusses the data and the empirical strategy used in this thesis. I start by discussing the different data sources used in the empirical setting and then move on to explaining carefully the hedonic pricing model and the difference-in-differences setting used in the empirical part of the thesis.

4.1 Data

4.1.1 KVKL Housing Market Data

The housing market data is a micro level data collected and maintained by the Central Federation of Finnish Real Estate Agencies (KVKL or Kiinteistövälittäjien Keskusliitto *in Finnish*). This data is used as the main source of data for the DID calculation. The data was gathered from KVKL's website portal "Hintaseurantapalvelu", which is a database containing all the transaction in the housing market handled by real estate agencies. The sample is not totally comprehensive but large enough for the purposes of this thesis.

The housing market data contains a necessary amount of variables for constructing the Hedonic Pricing model discussed in the following section such as the transaction price, which is my main dependent variable, the date of sale, exact location and many individual dwelling characteristics of the apartment for every transaction. These dwelling characteristics can be defined as characteristics that can be used to differentiate or value from each other i.e. structural type, floor area, number of rooms, conditions etc.

4.1.2 Other data sources

In addition to the housing market level data, other data sources were used, for example, to determine the exact location of each dwelling.

Helsinki Metropolitan Area address catalogue was downloaded from the Helsinki Region Infoshare (HRI) service. This is a open data service maintained by the municipalities in the HMA. In addition, maps containing the most recent city plan index where accessed through the HRI service. In addition, other data, for example City Plan Indexes" were collected from Helsinki Region Infoshare (HRI).

The Helsinki Region Time-series (aluesarjat.fi) was used to gather information on housing construction and the current dwelling stock. The website provides, for example, openly available information from Statistics Finland and The City of Helsinki.

4.2 Difference-in-Differences Setting

This chapter discusses the Difference-in-Differences setting used in the empirical section of this thesis. When attempting to answer my research question, two potential DID strategies were identified. In the first strategy, I compare prices near Myllypuro's shopping center to prices farther away from the shopping center around and inside Myllypuro, and in the second strategy, to prices near similar shopping centers in other comparable neighborhoods. These DID estimations are carried out by using a hedonic regression model explained in more detail later.

In the first strategy two different models are used. First, I study the effect on prices by using linear distance model . In this model the price of an apartment i at time t is expressed in the equation 1.

$$Ln(Price_{it}) = \alpha + \beta * distance_i + \gamma * distance_i * after_t + \sigma * x_{it} + \mu_t + \epsilon_{it} \quad (1)$$

In this model we are interested how does the price gradient change after the treatment happens. In this model, β is coefficient for the price gradient and it is defined as the change in price for every hundred meters moved away from the shopping center and γ is the coefficient for the interaction term of price gradient and after. α is the constant, σ is the coefficient for numerous dwelling characteristics, μ_t are the fixed effect and ϵ_i is the error term.

In addition, a more traditional model where I have a treatment and a control group is used. In this strategy, the treatment group is defined as apartments within a certain distance band from the shopping center and the control group as apartment farther away. This model is shown in equation 2

$$Ln(Price_{it}) = \alpha + \beta * treatment_i + \gamma * treatment_i * after_t + \sigma * x_{it} + \mu_t + \epsilon_i \quad (2)$$

In this model, β is the coefficient for being in the treatment group defined later and γ is the coefficient for the interaction term of being in a treatment group after the treatment started. α is the constant, σ is the coefficient for numerous dwelling characteristics, μ_t are the fixed effect and ϵ_i is the error term.

The second strategy, comparing prices in Myllypuro to comparable neighborhoods, is done using equation 2 as well. In this strategy, the treatment group consists of apartments within a certain distance band from Myllypuro's shopping center and the control group of apartments within a the same distance band from similar neighborhoods' shopping centers.

Both of the strategies presented have their advantages and disadvantages. While strategy 1 may be better for creating a control group with a better common trend, it is not clear how much does the shopping center affect the houses farther away i.e. does the strategy underestimate the true effect if the housing prices in the control group are affected as well. In this sense we do not get an answer to the causal effect of the shopping center on prices but rather the causal effect on price gradient of distance inside and close to Myllypuro. In addition, the infill development happening in the area is not evenly spatially distributed. Still, as the shopping center and the apartments above were built and completed at the same time, we can graphically examine what does the data suggest on the trends of the mean square meter prices for apartments.

While there are challenges in finding a good control group for strategy 2, the potential results can be of true value if the key identifying assumptions hold. The emphasis is on finding a neighborhood which has seen similar price trends before the year 2009 and preferably has not been a part of a neighborhood project of a similar magnitude. In addition, it would be important that the amount of infill development would not exceed the levels of Myllypuro, if there is a chance that infill development has a positive effect on the prices. Similar levels of infill development would be optimal as we would get closer to estimating the true causal effect of the new shopping center. While gathering information on what urban renewal actions has been done in the different neighborhoods studied, I emphasize the importance of finding a control group sufficiently satisfying the common trends assumption. The treatment and control groups in both models are discussed in more detail in the following subsection.

Both of the strategies were tested in a few different settings for apartments build in the 1960s and 1970s. This restriction is done purely to compare apples to apples as many of the neighborhoods studied were built in the 1960 and 1970s as I will discuss in more detail in the following section. The empirical estimations were repeated for apartments using different specifications for the control groups and for different distance bands.

A decent amount of data manipulation was needed to make the comparisons presented. To merge the housing market data with the location data, the names and of the streets were unified and combined with house numbers. As a results, out of the 195 331 sales transactions of multistory buildings sold between the beginning of 2003 and mid 2019, 181 168 (93%) were successfully matched with exact location level data. In the estimations, only the successfully merged transaction were used. The unmatched transactions are likely due to human error as the transaction are filled in manually for every transaction. This should not produce a biased estimation in any direction.

Before going into the DID estimation I show graphical evidence on yearly average prices for multiple different settings. This is done to validate if the common trends assumption is plausible for the empirical comparison I am proposing to make. After discussing the graphical evidence, I move on to presenting results from the viable DID models.

4.3 Treatment and control groups

In this subsection I explain the treatment and control groups used in the two different estimations and the reasoning for them. In both of the models, only the apartments close to the new shopping center are considered as treated. 400 meter distance bands are used to ensure that there are enough observations of relevant transactions in the data to ensure statistically significant results. However, the choice of a distance band remains somewhat arbitrary as in most of the empirical literature discussed in the literature review.

In the model 1, I estimate the change in prices within 2 000 meters from the new shopping centers using two different specifications. First, I consider the 0 to 400 meter and 400 to 800 meter distance bands as treated areas and consider the 1200 to 2000 meter band as the control area. This is done after graphical inspection of common trends and yearly estimates. Second, I estimate how does the price gradient change after the treatment happens. In the latter model there isn't a specific control group, but I am interested in the change of the gradient in the interaction term of distance and after. In addition, the same estimations are repeated on apartments within Myllypuro's official postal code only.

Similarly, for model 2, I start by assuming the houses affected by the new shopping center are mainly the ones located close to the new shopping center in two 400 meter distance bands in a similar manner compared to model 1. I continue the analysis by graphically showing the averages in mean square meter prices in all of the chosen control groups and showing yearly estimates for the changes. The 800 meter band is chosen as the maximum distance band since the distances between chosen neighborhoods are not long enough for other comparisons.

In model 2, I use similar neighborhoods that have multistory buildings built in the 1960s and 1970s as control groups. The neighborhoods of Kontula, Mellunmäki, Vuosaari and Itäkeskus are considered as candidates for being in the control group. All of the candidate control groups are situated by the eastern metro line and have shopping centers situated right by the metro stations. While Kontula and Vuosaari are the best matches for multistory buildings built in the 1960s, Itäkeskus and Mellunmäki provide a good comparison for multistory buildings built in the 1970s. Table 5 shows the dwelling stock in each of the chosen neighborhoods for multistory buildings built in 1960s and 1970s.

Table 5: Dwelling stock of Multistory buildings in 2012 (City of Helsinki, 2019a)

	1960 - 1969	1970 - 1979
Itäkeskus	0	1253
Myllypuro	3216	413
Kontula	5329	1088
Mellunmäki	512	1728
Vuosaari	3854	758

4.4 Hedonic Pricing Model

The hedonic pricing model was created solely based on the dwelling characteristics included in the housing market data and was used as the regression model in the DID estimation discussed earlier. Other characteristics, for example grid data containing information on the population was not available for this thesis.

Price is used as the dependent variable for the simple reason that it reflects the value that consumers give for the given product, in this case the value of the apartment. When controlling for structural dwelling characteristics and time fixed effects in the hedonic regression, in theory we can interpret the results as people's willingness to pay to live in that certain location or in other words as the neighborhood's quality.

Natural logarithm is used to quickly determine the percentage change in prices i.e. all the coefficient of the independent variables can be interpreted as percent change in the price of the apartment when the unit of the independent variable changes by one.

Distance was calculated for each location by merging two data sets: the housing market data and Helsinki Metropolitan Address catalogue. After acquiring coordinates for a great majority of the transactions in the housing market data, the straight line distances to shopping centers were calculated using the Pythagorean theorem which is accurate enough for the purposes of these relatively close DID calculations. For the model 1, the distance to Myllypuro's shopping center was calculated. For the model 2, also the distances to comparable shopping centers situated near the metro stations of the compared neighborhoods were calculated using the same Pythagorean theorem. The distance was calculated similarly for all the transaction locations.

The dwelling characteristics were gathered from the housing market data. When constructing the model, I am interested in the magnitude of the interaction term between after (sold after 2009 when the dismantling started) and treated (or distance), not the individual magnitude of the price effects of these dwelling characteristics variables. The dwelling characteristics can be divided into two: dummy variables (for example, number of rooms, year sold, year build, floor etc) and continuous variables (square meter area, maintenance charge). In summery, the use of these independent variables is to improve the precision of the estimates.

5 Results

In this section, I analyze the results by discussing both the graphical presentation of the change in prices and DID estimation when feasible. In addition, I discuss both the statistical inference and the robustness of the results before concluding the results.

5.1 Results from the distance model

Literature strongly suggests that if the spillover effects exists, especially in the case of infill development, it is strongest near the new development. Therefore, I start my analysis by comparing the price trends near the shopping center before and after the dismantling and the construction of the new shopping center started in Myllypuro. I focus on the prices of multistory buildings built in the 1960s and 1970s. The average square meter price trends for different distance bands around the shopping center are presented in figure 3. In addition, I estimate what has the change in the distant gradient been before and after the construction started. Descriptive statistics can be seen in table B.3 in the Appendix.

The graphical evidence seems to support the common trends assumption required for further DID estimation. The common trends assumption is formally satisfied later in figure 4 when looking at the yearly coefficients from the hedonic regression. Price trends for both 400 meter distance bands and for an alternative specification are seen in figure 3. Between the years 2005 and 2008 the average square meter prices are increasing in all the distance bands. The square meter prices for the apartments located within 400 meters of the shopping center remain the lowest between the years 2005 - 2009. After the year 2009, when the dismantling of the old shopping center started, the average price within 400 meters starts to rise and after 2015 the apartments within 400 meters are on average the most expensive once.

The largest relative jump in the prices seems to happen from 2009 to 2010, which could imply that a majority of the capitalization effect happens instantly after the construction work begins. Interestingly, another relatively large jump happens after 2012 when the construction finished. Both the average prices in distance bands 0 to 400 meters and 400 to 800 increase compared to the distance bands farther away. However, after 2010 the price in the 400 to 800 meter band seems to flatten while the prices within 400 meters keeps on the upward trend.

Based on the initial graphical analysis, the first two distance bands will be used as treatment groups and apartments between 800 to 2000 meters are used as a control group. The data from 2005 to 2018 are used in the estimations as the common trends are the strongest starting from 2005. Based on the price trends, it seems that the effect is the strongest in the 0 to 400 distance band. In addition, the prices in the distance band from 400 to 800 meters have increased relatively compared to prices between 800 and 2000 meters.

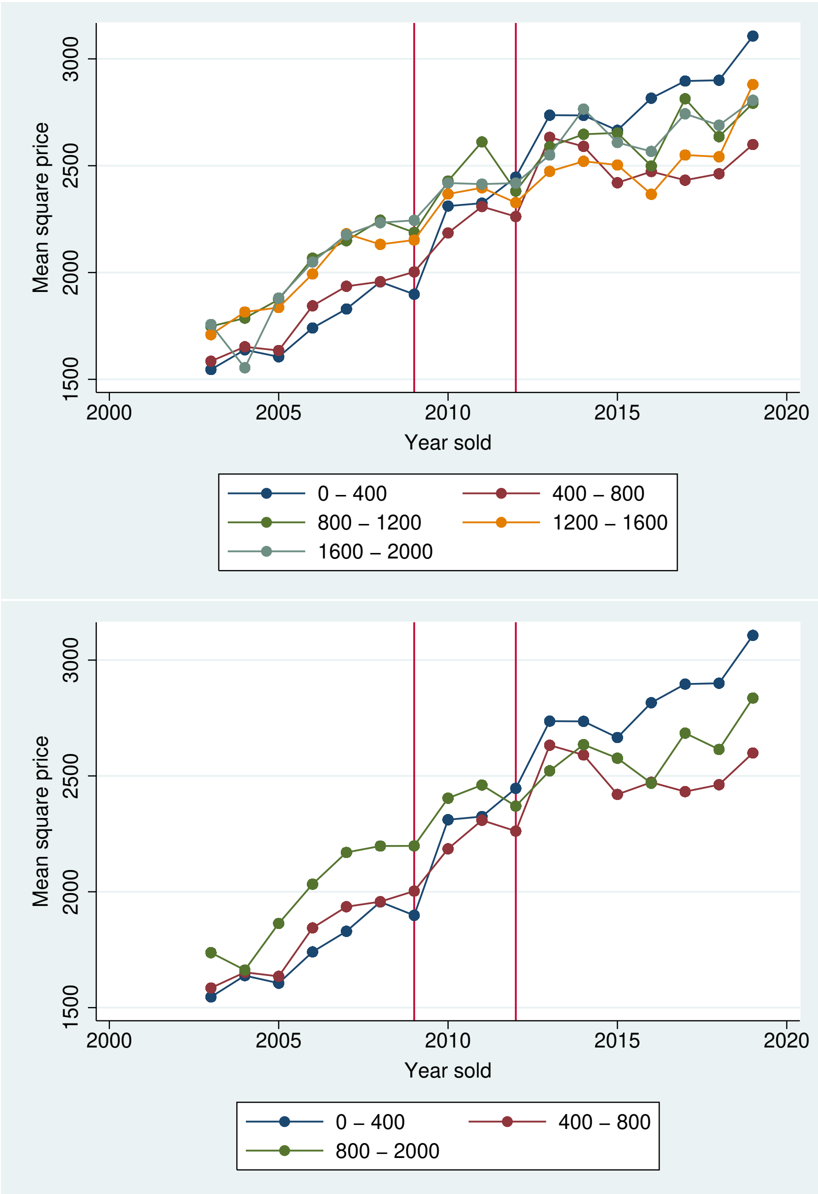
For a comparison, prices within Myllypuro's postal code are shown in figure A.1 in the Appendix. Only one 400 meter distance band was used as a potential treatment group to ensure enough observations in the control group. The common trends assumption seems to hold well for this specification as well.

Before looking at the results from the DID estimation, two further validations are needed to rationalize the empirical strategy. First, we look at descriptive statistics to understand the dwelling stock both in the treatment and the control group. Second, we look at yearly estimates to see whether the common trends assumption is satisfied and the hypothesis that the capitalization effect started when the construction started seems plausible based on the regression.

Descriptive statistics in table B.3 in the Appendix seem to support the common trends assumption as the dwelling characteristics are close to each other. The most interesting comparison is between the treatment group of 0 to 400 meters and the control group of 800 to 2000 meters. The apartments in the treatment group are on average a bit more expensive (14 000 euros) and slightly bigger (4 square meters), but otherwise similar in dwelling characteristics, for example, the maintenance charge, condition and year built are relatively close to each other. In the hedonic regression model, all these dwelling characteristics are used as explanatory variables.

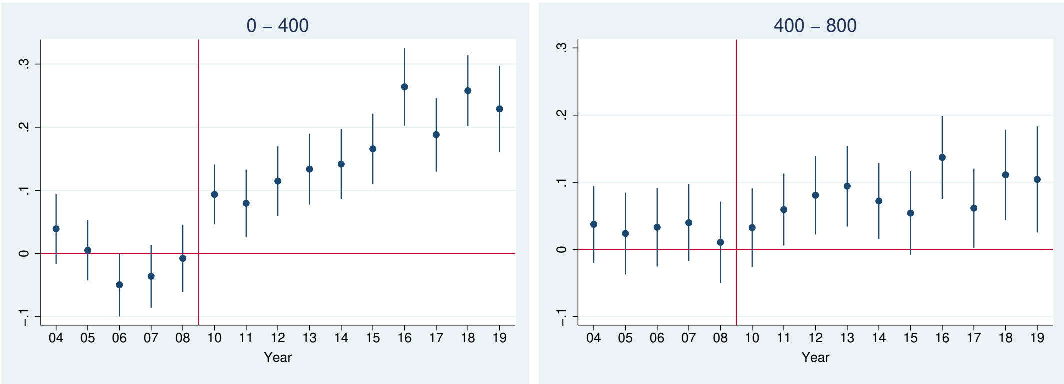
Yearly coefficients from the hedonic regression shown in figure 4 seem to support the common trends assumption as there is no difference between the treatment and control group before 2009. Also the hypothesis that the capitalization effect in the closest distance band happens immediately after the construction begins seems plausible. All of the yearly coefficient after the year 2009 are positive and significantly different from zero. What is even more puzzling is that the trend continues in the same direction and the difference between the control group and the treatment group seems to keep on widening.

Figure 3: Price trends near Myllypuro.



The yearly coefficients for the 400 to 800 meters distance band is not as convincing compared to the 0 to 400 meter band. Still, most of the coefficients after 2009 are positive and significantly different for zero, but there is no clear jump in the coefficients when the construction starts.

Figure 4: Coefficients of yearly estimates in Myllypuro, year 2009 omitted.



(a) Myllypuro 0 - 400 (b) Myllypuro 400 - 800

Notes: The coefficients of yearly estimates are estimated using the hedonic regression model discussed in the previous section. The apartments between 800 and 2000 meters are used as a control group. The natural logarithm of the price is used as the dependant variable and all the dwelling characteristics shown in table B.3 in the Appendix are used as controls in the regression. Each yearly coefficient can be interpreted as the difference between the treatment and the control group.

The results from the DID estimation seen in table 6 confirm the hypothesis that prices have increased relatively faster in the closest distance bands compared to the control distances. In the first column, 0 to 400 meters and 400 to 800 meters distance bands are used as treatment groups. In the second column, there are no control groups but the effect for every 100 meters away from the shopping center are calculated. In column 3 and 4, only observation from Myllypuro's official zip codes are used.

The prices within 400 meters from the shopping center have increased over 15 percent relative to prices over 800 meters away and the same effect for prices from 400 to 800 meters is at almost 4 percent between the years 2010 and 2018. This implies that prices in the former group have annually increased at 1.4 percent faster rate compared to the control group. Within Myllypuro's zip code the effect is over 11 percent over the same period. The difference makes sense, since we can safely assume that urban renewal actions have affected in some portion all areas in Myllypuro.

From the distance estimation, the change in the price gradient tells a similar story. Before 2009 the apartment prices increased half percent for every hundred meters moved farther from the shopping center. After 2009 this relationship changed and prices near the sopping center are now more expensive compared to the ones farther away. The change within Myllypuro's zip code is even more radical going from being 2% more expensive to 1% less expensive for moving 100 meters farther from the shopping center.

We can see from graphical evidence that the mean prices in the treatment and control areas were developing in common trends. However, this does not mean that the empirical strategy is flawless and there are two main issues that should be taken into consideration. First, the hedonic regression model used is able to explain around 80% of the variation in prices. The Adjusted R^2 could be increased by using grid level statistics including household characteristics on income, education levels etc for example. Second, the treatment is fuzzy by definition and lots of other changes are going on in Myllypuro in addition to the new shopping center. It cannot be assumed that the change in prices is wholly explained by the shopping center and therefore the price effect is only suggestive of causality. We cannot be certain about the spatial distribution of these changes that affect the prices in these neighborhoods.

Table 6: Price effect in Myllypuro 2009 - 2018

Ln (Price)	(1)	(2)	(3)	(4)
treated_400	-0.0911***		-0.0621***	
	(0.0102)		(0.0123)	
treated_after_400	0.154***		0.114***	
	(0.0123)		(0.0140)	
treated_400_800	-0.0231			
	(0.0122)			
treated_after_400_800	0.0382**			
	(0.0142)			
distance_100		0.00508***		0.0229***
		(0.000680)		(0.00325)
distance_100_after		-0.00777***		-0.0344***
		(0.000813)		(0.00379)
Observations	4096	4096	1016	1016
Adjusted R^2	0.777	0.773	0.855	0.856

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

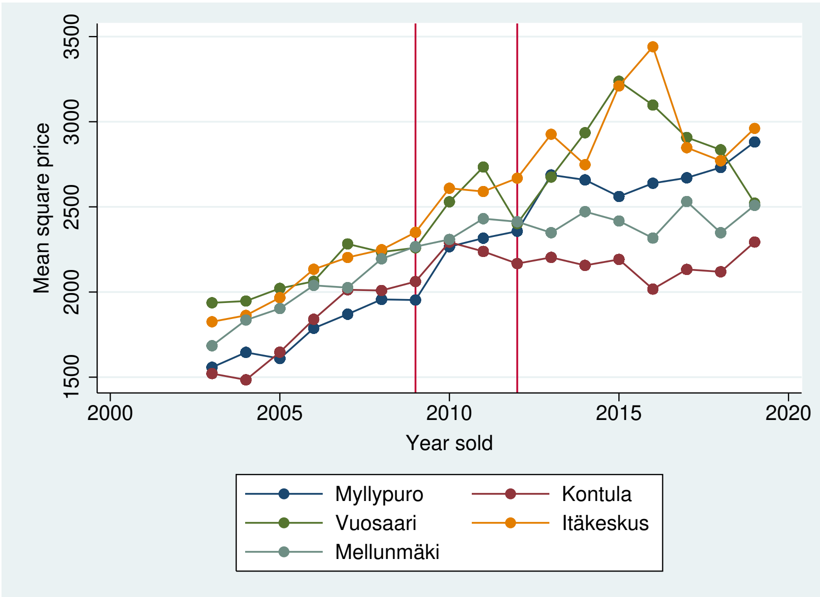
Notes: The DID estimation is estimated with a hedonic regression. All the dwelling characteristics shown in table B.3 in the Appendix are used as controls in the regression. Column 1 shows the main estimation, comparing apartment prices within 800 meters from the shopping center to prices of apartment 800 to 2000 meters away from the shopping center. Column 2 show the change in the price gradient for every hundred meters within the same specification. Column 3 and 4 are otherwise similar to the 1 and 2 respectively, but only houses within Myllypuro's postal code are examined. Full regression table shown in table B.1 in the Appendix.

5.2 Results from the control group model

In this section I compare Myllypuro to nearby neighborhoods with similar dwelling stock. This subsection is divided in the same way as the previous results section. Before discussing the results, the plausibility of common trends are discussed by looking at price trends and yearly coefficients. In addition, the chosen control neighborhoods are discussed again.

Graphical comparison for price trends between housing prices in candidate control neighborhoods can be seen in figure 5. The figure shows the prices for apartments build in the 1970s and 1980s and are situated within 800 meters from the shopping centers situated by the metro stations of each neighborhoods. These neighborhoods were chosen for closer inspection for reasons already mentioned in section 5. They all have dwelling stock from the 60s and 70s, are situated in the east and have a metro station/shopping center combination in the center of each neighborhood.

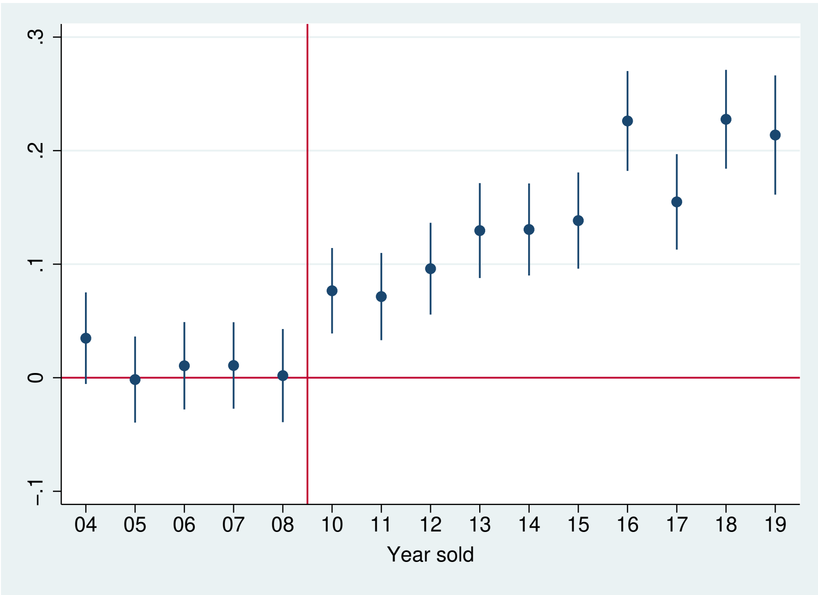
Figure 5: Price trends in control neighborhoods. 800 meters from local shopping centers.



We can see from figure 5 that the general average price per square meter has been increasing in all the neighborhoods until 2010 and the trends have been interestingly similar. Especially when looking from 2005 to 2009, the prices have evolved in similarly in Myllypuro, Kontula and Itäkeskus. However, Mellunmäki and Vuosaari are not bad comparisons either. The same cannot be concluded for trends in the distance bands of 0 to 400 meters and 400 to 800 meters which can be seen in figure A.2 in the Appendix. In the main results, the distance band within 800 meters is used as the common trends assumption seems most convincing. Again, years from 2005 to 2018 are used in the estimation. The graph comparing the combined treatment group of all the neighborhoods and control group is showed in figure A.3 in the Appendix. It is important to keep in mind that these common trends in the mean square prices are only one indicator of common trends. More proof is needed in the form of yearly estimations.

Both the descriptive statistics and the yearly coefficients make the common trends assumption seem plausible. In table B.4 in the Appendix, we can see that apartments in the treatment group are slightly more expensive (9 700 euros), slightly bigger (3.4 square meters) and slightly older (4 years). However, otherwise the houses seem to be in similar condition. The descriptive statistics for alternative treatments and control groups can be seen in table B.5 in the Appendix. In figure 6, yearly estimates are displayed for the main estimation and in figure A.4 in the appendix for alternative models. The common trends assumption seems to hold well after 2005 for the 400 meter and 800 meter distance bands but no as well for the 400 to 800 meter distance band. After the year 2009, when the construction started, prices have increased faster in Myllypuro compared to the control group including all the neighborhoods displayed in figure 5. Yearly coefficient for the 0 to 400 meter and 400 to 800 meter distance bands are shown in figure A.2 in the Appendix. Even without satisfying the common trends assumption, it can be safely concluded that prices Myllypuro have significantly increased, especially near the shopping center, relative to close-by neighborhoods.

Figure 6: Control group model: Yearly coefficients 800 meters from local shopping centers, year 2009 omitted.



Notes: The coefficients of yearly estimates are estimated using the hedonic regression model discussed in the previous section. Apartments within 800 meters from Myllypuro's shopping center are compared to the prices of apartment in the same distance band of the control groups shown in figure 5. The natural logarithm of the price is used as the dependant variable and all the dwelling characteristics shown in table B.4 in the Appendix are used as controls in the regression. Each yearly coefficient can be interpreted as the difference between the treatment and the control group.

Table 7 shows the results for the previously discussed distance bands. During the ten years between 2009 and 2018, prices have increased almost 11 percent faster within 800 meters from Myllypuro's shopping center compared to the same distance in the control neighborhoods and the results are statistically significant at 1 percent. When looking at the 400 meter distance band, prices have increased even faster, at almost 16 percent, compared to the control group. However, as discussed earlier, the first two distance bands in table 7 do not have as convincing common trends and the results should be interpreted as descriptive.

Table 7: Control group model: Price effect from 2009 to 2018.

Ln(Price)	(1) 0 - 400	(2) 400 - 800	(3) 0 - 800
treated	-0.0914***	-0.00840	-0.0622***
	(0.0119)	(0.0117)	(0.00799)
treated*after	0.156***	0.0362**	0.108***
	(0.0140)	(0.0137)	(0.00944)
Observations	1452	3330	4782
Adjusted R^2	0.799	0.779	0.778

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The DID estimation is estimated with a hedonic regression. All the dwelling characteristics shown in tables B.4 and B.5 in the Appendix are used as controls. All the models are formed in a similar manner. In the column 1, prices of apartments within 400 meters from Myllypuro's shopping center are compared to the prices of apartment in the same distance band of the control groups shown in figure 5. Full regression table shown in table B.2 in the Appendix.

Results shown in this section should be taken with a grain of salt. Based on the results, prices in Myllypuro have increased at a faster rate of 4 to 16 percent compared to the control group. What percentage of this increase we can contribute to the new shopping center, infill development and other urban renewal actions done in Myllypuro? I want to remind that Kontula too was part of the Neighborhood and Urban project but the price trends have been completely different. One possible explanation comes from infill development. As we saw in table 4 in section 4, the amount of new apartments constructed and taken into use in Myllypuro in 2010s has been triple compared to other neighborhoods. A large chunk of these apartment have been in the shopping center complex and in addition the new campus of Metropolia could makes the results biased upwards.

In addition, there are two issues that threaten the statistical inference. First, the urban renewal in Myllypuro could have had spillover effects on the close-by neighborhoods as Myllypuro becomes a relatively a better neighborhood to live in. Second, standard errors are not clustered by district areas as there are not enough potential clusters to be used. For example, Angrist and Pischke (2008) do not recommend clustering if there are only a few potential clusters as there is a great risk of underestimating serial correlation. In this context, it seems quite unlikely that there has been cluster specific shock not correlated with close-by neighborhoods. In addition, the results are significantly different from zero and increasing the standard errors should not affect the statistical significance of the final results. I tackle the first issue by using multiple difference-in-differences strategies and the second with using alternative control groups to show the robustness of the results.

5.3 Results from an alternative control group

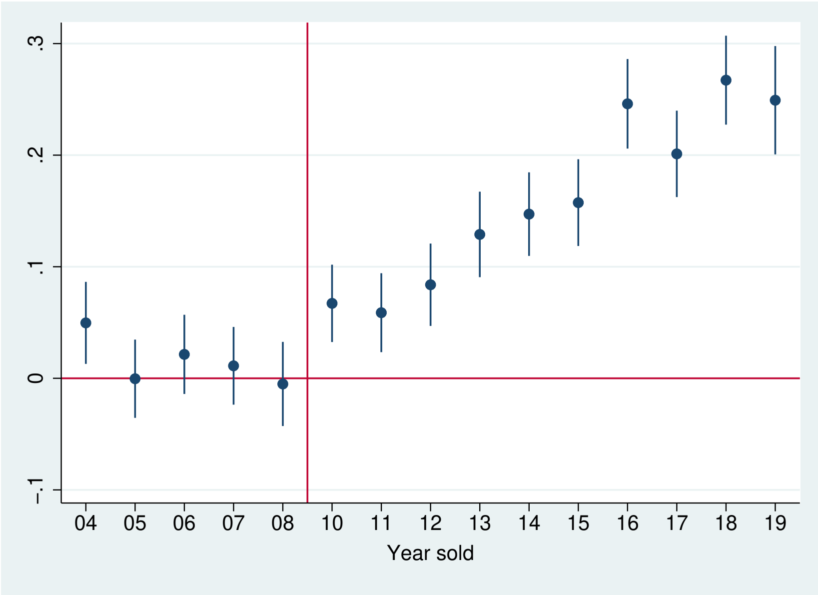
The control group specification in the previous section was chosen arbitrarily by combining all the potential neighborhoods situated by the metro in Eastern Helsinki and have dwelling stock from the 1960s and 1970s. To test the robustness of the results, I use an alternative control group consisting of only Kontula and Mellunmäki. Kontula and Mellunmäki were chosen as the alternative control group for two main reasons. First, they both situate by the same metro line with Myllypuro as the three last stations. Second, as was shown earlier, the dwelling stock is similar in all three neighborhoods.

Based on the graphical analysis in figure 5, the yearly coefficients in figure 7 and descriptive statistics in table B.4 in the Appendix, the common trends assumption seems plausible starting from 2005. Again, we can see from coefficient of yearly estimates in figure 7 that there seems to be a jump in the difference after 2009. The same can be said for the distance band of 0 to 400 meters but not for the distance band of 400 to 800 meters shown in figure A.5 in the Appendix.

Table 8 shows the results for the alternative control group specification. All the DID coefficients have increased a bit but are still in the same ballpark as the main specification, and are still statistically significant. This means that prices of old apartments in Myllypuro have increased even faster compared to the alternative control group. In the alternative regression, prices within 800 meters from Myllypuro's shopping center have increased 11.4% faster compared to the prices within same distance bands in Kontula and Mellunmäki. This is an 0.4 percentage point increase compared to the preferred specification. Also the estimations for the 400 meter and 400 to 800 meters distance bands have increased by 2 and 1 percentage points respectively compared to the preferred specification.

In conclusion, the results seem to be robust for alternative specifications. Dropping Vuosaari and Itäkeskus from the estimation do not change the results radically and the common trends assumption seems to still hold well. However, one can ask if the spillover effects are stronger now as the control groups are even more similar and therefore the estimates could be biased upwards.

Figure 7: Alternative control group: Yearly coefficients 800 meters from local shopping centers. 2009 omitted.



Notes: The coefficients of yearly estimates are estimated using the hedonic regression model discussed in the previous section. Apartments within 800 meters from Myllypuro's shopping center are compared to the prices of apartment in the same distance band of Kontula and Mellunmäki. The natural logarithm of the price is used as the dependant variable and all the dwelling characteristics shown table B.4 in the Appendix are used as controls in the regression. Each yearly coefficient can be interpreted as the difference between the treatment and the control group.

Table 8: Alternative control group: Price effect from 2009 to 2018.

Ln(Price)	(1) 0 - 400	(2) 400 - 800	(3) 0 - 800
treated	-0.0240***	0.0157	-0.0196*
	(0.0143)	(0.0106)	(0.00801)
treated*after	0.176***	0.0463***	0.112***
	(0.0146)	(0.0121)	(0.00876)
Observations	1107	2576	3683
Adjusted R^2	0.822	0.816	0.810

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The DID estimation is estimated with a hedonic regression. All the dwelling characteristics shown in tables B.4 and B.5 in the Appendix are used as controls. All the models are formed in a similar manner. In the column 1, prices of apartments within 400 meters from Myllypuro's shopping center are compared to the prices of apartments in the same distance band of an alternative control group consisting of neighborhoods situated on the same metro line: Kontula and Mellunmäki.

5.4 Discussion and comparison to previous literature

In conclusion, it can be safely stated that the prices of old apartments near the new shopping center in Myllypuro have significantly increased. The prices have grown 4 to 16 percent faster relative to prices farther away in Myllypuro and prices in similar neighborhoods over a ten year period. With the caveats in mind, it can be concluded that the combination of the new shopping center and amount of infill development has been a contributing factor in the price developments discussed in the results section. The results are robust for alternative specifications.

This study and the causal implications could be further improved by using additional data sets as discussed earlier. Grid base date could be used to see if the population factors in the areas have an effect on the results. Also, having exact locations on the infill development in each neighborhood could make the results presented more robust. Now only aggregate level information on infill development is used when interpreting the results.

In addition, the studied neighborhoods are geographically located close to each other and one could argue, that the effect seen in the results are overestimated if Myllypuro has become a relatively a better place to live compared to Kontula for example. In other words the renewal in Myllypuro could have spillover effects in Kontula. This furthermore adds to the fuzzy nature of this study. However, the results are quite large and the signs and statistical significance of the results are clear.

I find that the results in this study are in par with the empirical literature discussed in the literature section. New studies relatively closest to mine focusing on multistory buildings (Ahvenniemi et al., 2018; Kurvinen and Vihola, 2016; Ooi and Le, 2013) show mainly positive results. Furthermore, studies discussing other neighborhood amenities (Ahlfeldt and Kavetsos, 2014; Harjunen, 2018) show positive spillover effects.

6 Conclusion

In this paper, I have showed that prices of old apartments near the new shopping center in Myllypuro, after the construction started in 2009, have significantly increased compared to the prices of apartments farther away or in comparable distance bands of similar neighborhoods situated by the eastern metro line. The cumulative growth has been 4 to 16 percent faster over a 10 year period. Based on this study, the most visible thing that has changed in Myllypuro compared to close-by neighborhoods has been the new shopping center and amounts of infill development in the 2010s.

However, not all of the results of this thesis can be considered as causal and graphical analysis is done to satisfy the common trends assumption when feasible. This analysis is based on the assumption that the treatment is fuzzy, containing mixed urban renewal actions in addition to the new shopping center. The common trends give credibility to the results.

The magnitude of these results can be estimated by making a few back of the envelope calculations. From the first model, we can estimate that the capitalization effect, on the old apartments within 400 meters from the shopping center, was 26 million assuming that 50% of old dwelling stock in Myllypuro was inside that distance band. Making the same calculations for model 2 and assuming that 80% of the dwelling stock was within the 800 meter distance band, the capitalization effect on the old apartments has been 41 million over the last 10 years,

In conclusion, the results of this study are highly relevant for urban policy decision makers. Earlier we saw that Myllypuro had been a part of a urban renewal actions long before the new shopping center was built. Why we cannot see this in the data? This could suggest that planning and construction has a vital role in improving neighborhood quality. A natural continuation would be to study whether the population living in these apartments, and thus their willingness to pay, has changed during the study period.

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Appendices

A Common trends

Figure A.1: Price trends inside Myllypuro's postal code.

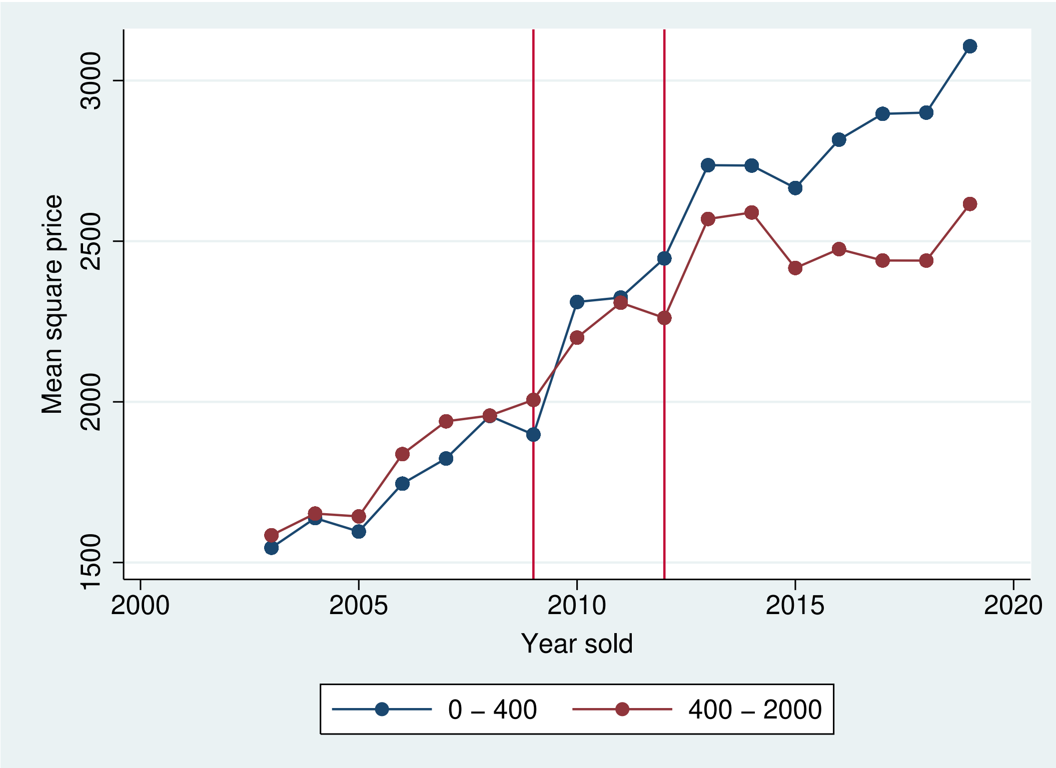
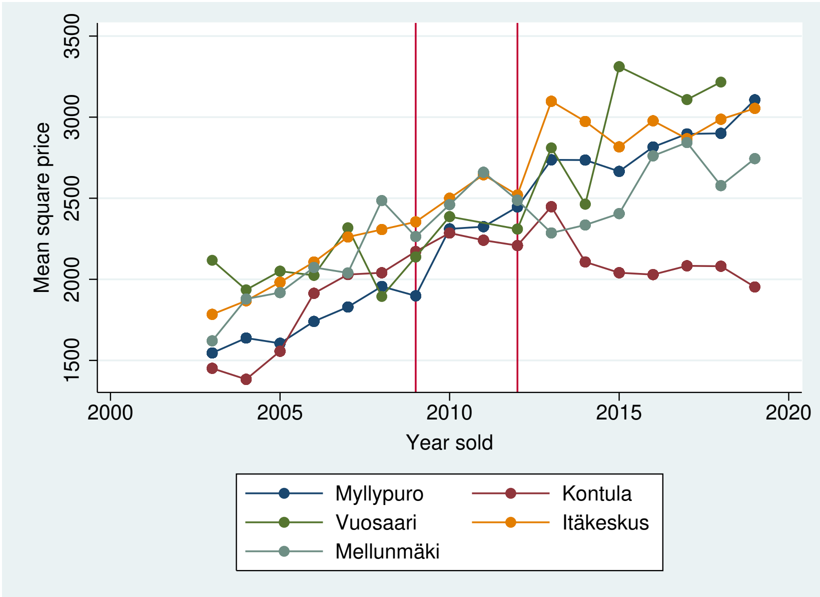
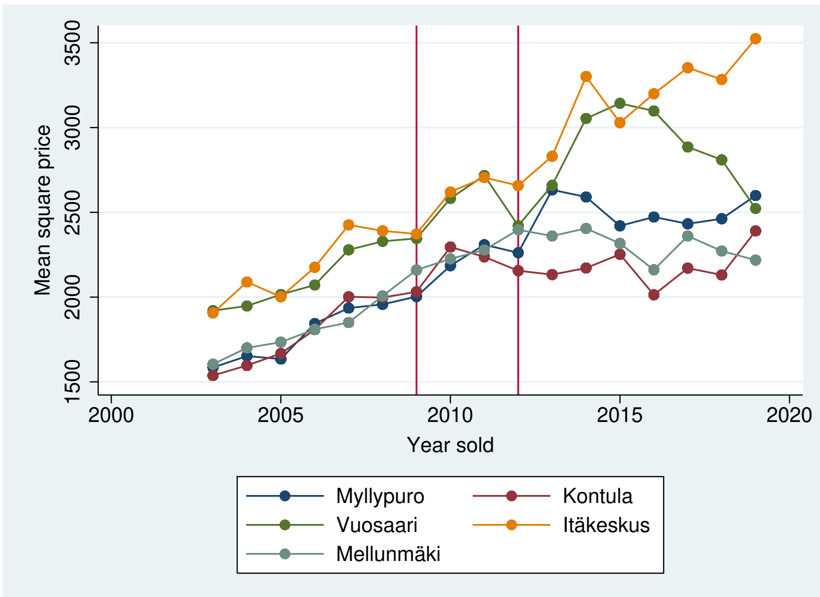


Figure A.2: Price trends in control neighborhoods. Distance to shopping centers.

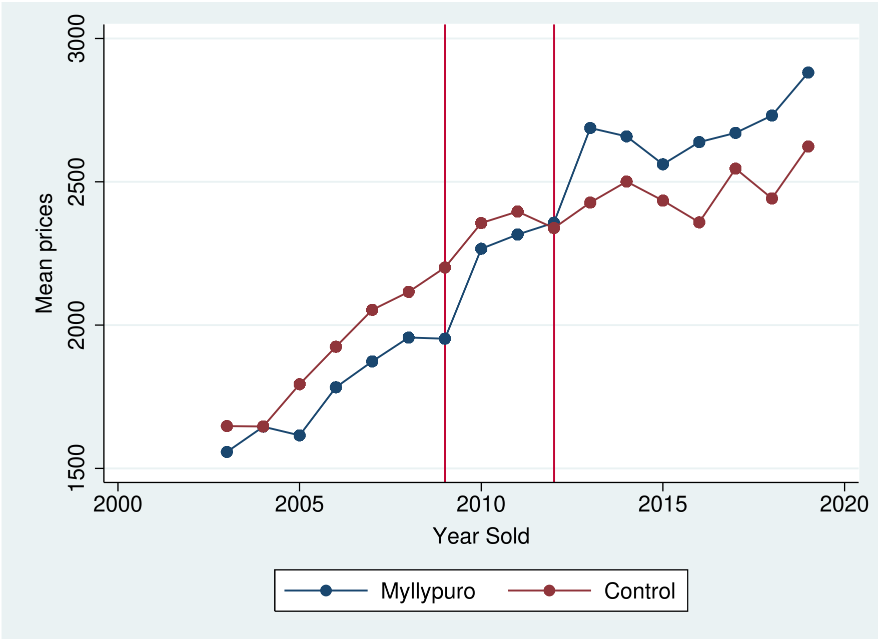


(a) 0 - 400

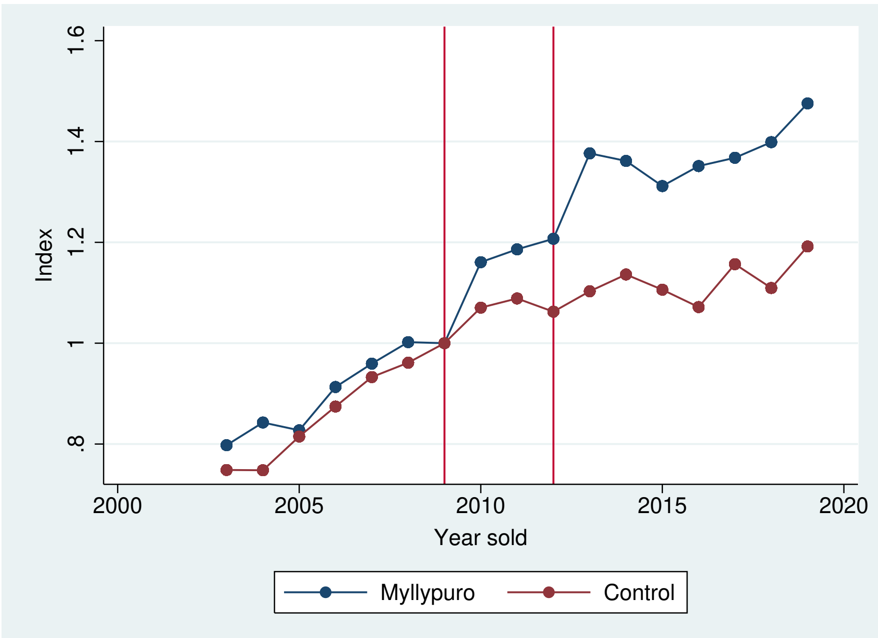


(b) 400 - 800

Figure A.3: Price trends 800 meters from shopping centers. Combined control group.



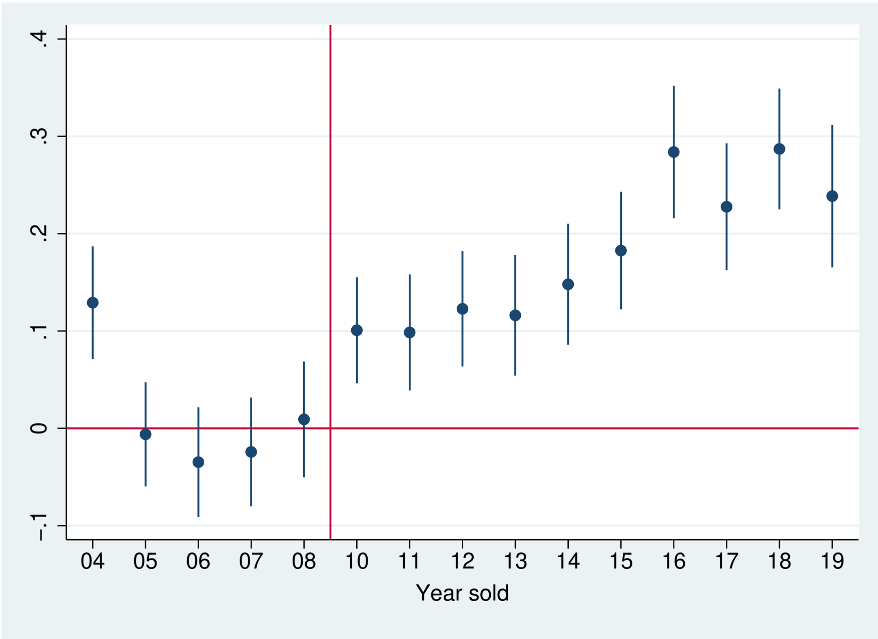
(a) Mean prices



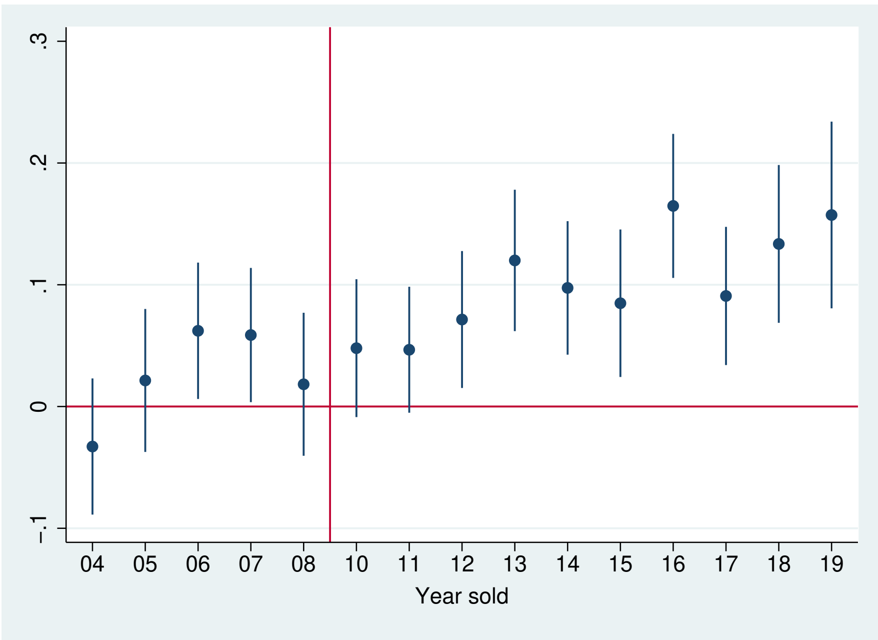
(b) Indexed to 2009

Notes: Control group consists of Kontula, Vuosaari, Itäkeskus and Mellunmäki. In figure (b), prices indexed to 2009.

Figure A.4: Control group model: Yearly coefficients for alternative distance band. Year 2009 omitted.



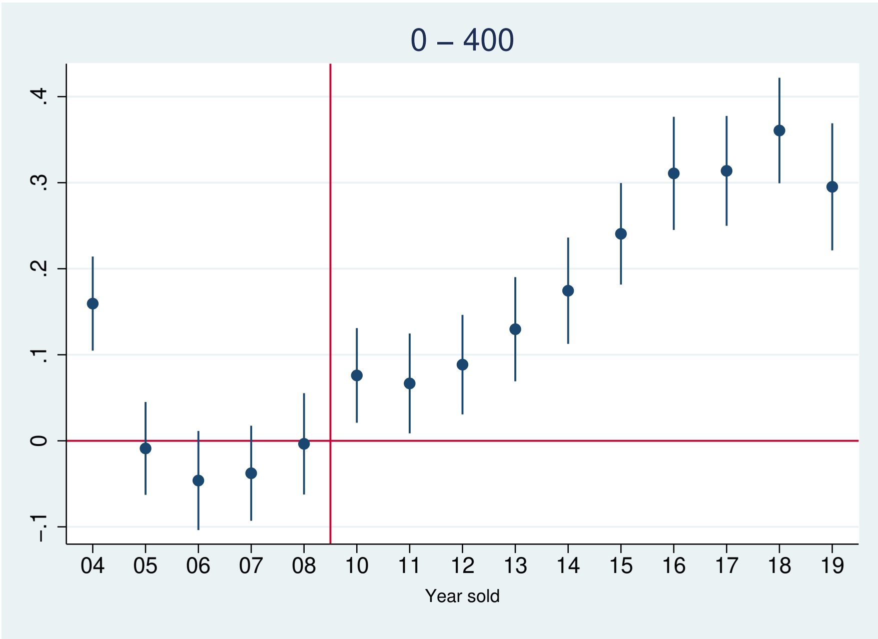
(a) 0 - 400



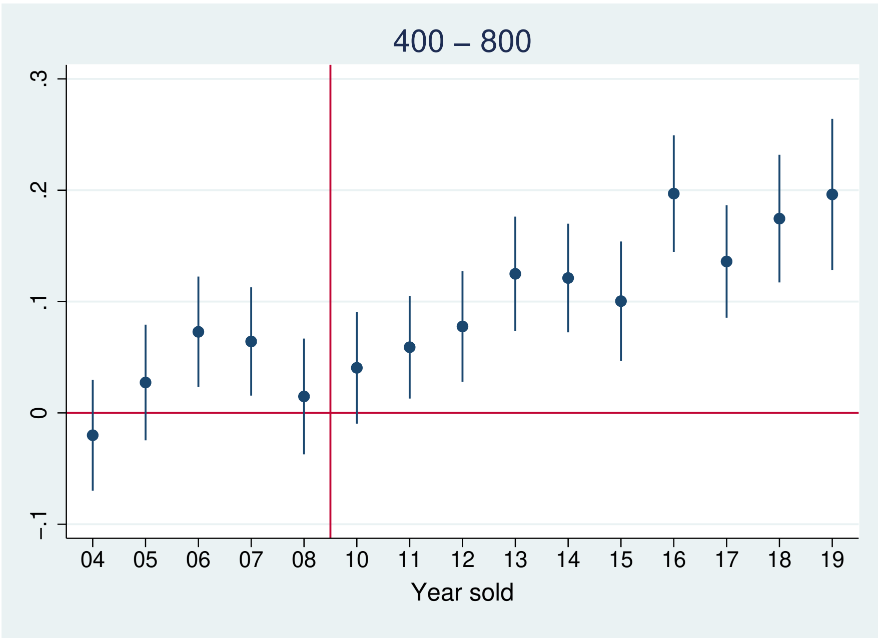
(b) 400 - 800

Notes: The coefficients of yearly estimates are estimated using the hedonic regression model. Apartments within the distance bands of 0 to 400 meters and 400 meters to 800 meters from Myllypuro's shopping center are compared to the prices of apartment in the same distance bands of the control groups shown in figure 5. The natural logarithm of the price is used as the dependant variable and all the dwelling characteristics shown in table B.3 in the appendix are used as controls in the regression. Each yearly coefficient can be interpreted as the difference between the treatment and the control group.

Figure A.5: Alternative control group: Yearly coefficients for alternative distance bands. Year 2009 omitted.



(a) 0 - 400



(b) 400 - 800

Notes: The coefficients of yearly estimates are estimated using the hedonic regression model. Apartments within the distance bands of 0 to 400 meters and 400 meters to 800 meters from Myllypuro's shopping center are compared to the prices of apartment in the same distance bands of the control group of Kontula and Mellunmäki. The natural logarithm of the price is used as the dependant variable and all the dwelling characteristics shown in table B.3 in the appendix are used as controls in the regression. Each yearly coefficient can be interpreted as the difference between the treatment and the control group.

B Regression tables and descriptive statistics

Table B.1: Price effect in Myllypuro 2009 - 2018

Ln (Price)	(1)	(2)	(3)	(4)
Area	0.00864***	0.00869***	0.00989***	0.00954***
	(0.000394)	(0.000395)	(0.000775)	(0.000771)
Rooms 1	0	0	0	0
	(.)	(.)	(.)	(.)
Rooms 2	0.130***	0.131***	0.103***	0.106***
	(0.0102)	(0.0102)	(0.0202)	(0.0200)
Rooms 3	0.183***	0.185***	0.122***	0.130***
	(0.0160)	(0.0161)	(0.0319)	(0.0317)
Rooms 4	0.227***	0.228***	0.173***	0.181***
	(0.0221)	(0.0222)	(0.0448)	(0.0445)
Rooms 5	0.277***	0.278***	0.182**	0.201***
	(0.0292)	(0.0294)	(0.0606)	(0.0602)
Rooms 6	0.282***	0.282***	0.258**	0.271**
	(0.0589)	(0.0593)	(0.0889)	(0.0885)
Floor level 1	0	0	0	0
	(.)	(.)	(.)	(.)
Floor level 2	0.00227	0.00156	0.0138	0.0170
	(0.00613)	(0.00617)	(0.0107)	(0.0106)
Floor level 3	-0.00128	-0.00182	0.0153	0.0200
	(0.00628)	(0.00633)	(0.0106)	(0.0106)
Floor level 4	-0.0237**	-0.0244***	0.00194	0.00594
	(0.00731)	(0.00737)	(0.0111)	(0.0111)
Floor level 5	-0.0185*	-0.0179*	0.0248	0.0297*
	(0.00823)	(0.00829)	(0.0130)	(0.0130)
Floor level 6	-0.0188*	-0.0203*	0.0308*	0.0342*
	(0.00940)	(0.00946)	(0.0150)	(0.0149)
Floor level 7	-0.0167	-0.0155	0.0437**	0.0486***
	(0.00901)	(0.00907)	(0.0140)	(0.0140)
Floor level 8	-0.00883	-0.0107	0.0527*	0.0534*
	(0.0107)	(0.0108)	(0.0235)	(0.0235)
Floor level 9	0.0231	0.0209		
	(0.0198)	(0.0200)		

Maintenance charge	-0.000693***	-0.000712***	-0.000792***	-0.000752***
	(0.0000519)	(0.0000519)	(0.000105)	(0.000105)
condition_unknown	-0.136***	-0.136***	-0.114***	-0.107***
	(0.0122)	(0.0123)	(0.0188)	(0.0187)
condition_bad	0	0	0	0
	(.)	(.)	(.)	(.)
condition_ok	-0.0459***	-0.0450***	-0.0475***	-0.0420**
	(0.00949)	(0.00956)	(0.0143)	(0.0143)
condition_good	0.0503***	0.0506***	0.0428**	0.0474**
	(0.00949)	(0.00956)	(0.0144)	(0.0144)
condition_excellent	0.181***	0.178***	0.0622	0.0464
	(0.0487)	(0.0491)	(0.105)	(0.104)
built_60_64	-0.0301**	-0.0286**	0.0484**	0.0598***
	(0.0100)	(0.0102)	(0.0185)	(0.0177)
built_65_69	-0.143***	-0.142***	0.00325	0.00961
	(0.00986)	(0.0101)	(0.0179)	(0.0175)
built_70_74	-0.108***	-0.106***	0.0426	0.0412
	(0.0121)	(0.0122)	(0.0295)	(0.0294)
built_75_79	0	0	0	0
	(.)	(.)	(.)	(.)
year_sold=2005	0	0	0	0
	(.)	(.)	(.)	(.)
year_sold=2006	0.101***	0.103***	0.0735***	0.0709***
	(0.0104)	(0.0105)	(0.0159)	(0.0158)
year_sold=2007	0.161***	0.163***	0.151***	0.145***
	(0.00988)	(0.00995)	(0.0158)	(0.0158)
year_sold=2008	0.174***	0.175***	0.161***	0.166***
	(0.0105)	(0.0106)	(0.0167)	(0.0165)
year_sold=2009	0.161***	0.282***	0.112***	0.315***
	(0.0105)	(0.0140)	(0.0184)	(0.0216)
year_sold=2010	0.270***	0.393***	0.271***	0.478***
	(0.0102)	(0.0137)	(0.0182)	(0.0209)
year_sold=2011	0.297***	0.417***	0.300***	0.498***
	(0.0107)	(0.0140)	(0.0188)	(0.0215)
year_sold=2012	0.316***	0.437***	0.342***	0.548***
	(0.0108)	(0.0142)	(0.0199)	(0.0228)

year_sold=2013	0.374***	0.494***	0.412***	0.612***
	(0.0116)	(0.0146)	(0.0207)	(0.0229)
year_sold=2014	0.392***	0.513***	0.427***	0.624***
	(0.0114)	(0.0145)	(0.0200)	(0.0222)
year_sold=2015	0.377***	0.498***	0.414***	0.617***
	(0.0114)	(0.0146)	(0.0209)	(0.0230)
year_sold=2016	0.386***	0.507***	0.494***	0.693***
	(0.0121)	(0.0151)	(0.0216)	(0.0238)
year_sold=2017	0.434***	0.555***	0.483***	0.681***
	(0.0118)	(0.0149)	(0.0207)	(0.0228)
year_sold=2018	0.435***	0.558***	0.539***	0.740***
	(0.0118)	(0.0150)	(0.0221)	(0.0235)
treated_400	-0.0911***		-0.0621***	
	(0.0102)		(0.0123)	
treated_after_400	0.154***		0.114***	
	(0.0123)		(0.0140)	
treated_400_800	-0.0231			
	(0.0122)			
treated_after_400_800	0.0382**			
	(0.0142)			
distance_100		0.00508***		0.0229***
		(0.000680)		(0.00325)
distance_100_after		-0.00777***		-0.0344***
		(0.000813)		(0.00379)
Constant	11.08***	11.00***	10.92***	10.78***
	(0.0191)	(0.0217)	(0.0367)	(0.0383)
Observations	4096	4096	1016	1016
Adjusted R^2	0.777	0.773	0.855	0.856

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The DID estimation is estimated with a hedonic regression. All the dwelling characteristics shown in table B.3 in the appendix are used as controls in the regression. Column 1 shows the main estimation, comparing apartment prices within 800 meters from the shopping center to prices of apartment 800 to 2000 meters away from the shopping center. Column 2 show the change in the price gradient for every hundred meters within the same specification. Column 3 and 4 are otherwise similar to the 1 and 2 respectively, but only houses within Myllypuro's postal code are examined.

Table B.2: Control group model: regression results

Ln (Price)	(1) 0 - 400	(2) 400 - 800	(3) 0 - 800
Area	0.0126***	0.00894***	0.00985***
	(0.000738)	(0.000397)	(0.000354)
Rooms=1	0	0	0
	(.)	(.)	(.)
Rooms=2	0.0686***	0.0774***	0.0758***
	(0.0175)	(0.0102)	(0.00888)
Rooms=3	0.0825**	0.135***	0.126***
	(0.0288)	(0.0163)	(0.0142)
Rooms=4	0.0817*	0.168***	0.152***
	(0.0405)	(0.0222)	(0.0196)
Rooms=5	0.121*	0.204***	0.192***
	(0.0500)	(0.0298)	(0.0256)
Rooms=6	0.268*	0.178**	0.192***
	(0.132)	(0.0601)	(0.0552)
Maintenance charge	-0.00127***	-0.000543***	-0.000762***
	(0.000100)	(0.0000580)	(0.0000504)
condition_unknown	-0.140***	-0.116***	-0.126***
	(0.0200)	(0.0131)	(0.0112)
condition_bad	0	0	0
	(.)	(.)	(.)
condition_ok	-0.0560***	-0.0511***	-0.0524***
	(0.0150)	(0.00976)	(0.00832)
condition_good	0.0290	0.0462***	0.0408***
	(0.0150)	(0.00981)	(0.00835)
condition_excellent	0.151	0.284***	0.249***
	(0.0868)	(0.0505)	(0.0444)
Floor number 1	0	0	0
	(.)	(.)	(.)
Floor number 2	0.0110	0.0105	0.0126*
	(0.0111)	(0.00650)	(0.00570)
Floor number 3	0.00971	0.0145*	0.0142*
	(0.0111)	(0.00663)	(0.00578)
Floor number 4	-0.00868	0.0141	0.00574
	(0.0117)	(0.00743)	(0.00635)
Floor number 5	0.00663	0.0175*	0.0120
	(0.0124)	(0.00823)	(0.00692)
Floor number 6	-0.00232	0.0362***	0.0194*
	(0.0136)	(0.0106)	(0.00833)

Floor number 7	0.00595	0.00978	0.00953
	(0.0137)	(0.0105)	(0.00833)
Floor number 8	0.00118	0.0248*	0.0171
	(0.0190)	(0.0116)	(0.0100)
Floor number 9	0.0156	0.0322	0.0272
	(0.0353)	(0.0195)	(0.0173)
built_60_64	-0.0406**	0.0896***	0.0452***
	(0.0146)	(0.00956)	(0.00799)
built_65_69	-0.141***	-0.0350***	-0.0683***
	(0.0140)	(0.00862)	(0.00742)
built_70_74	-0.117***	-0.0145	-0.0478***
	(0.0156)	(0.00917)	(0.00792)
built_75_79	0	0	0
	(.)	(.)	(.)
year_sold=2005	0	0	0
	(.)	(.)	(.)
year_sold=2006	0.0840***	0.0699***	0.0696***
	(0.0155)	(0.0108)	(0.00900)
year_sold=2007	0.146***	0.150***	0.145***
	(0.0154)	(0.0105)	(0.00876)
year_sold=2008	0.169***	0.173***	0.168***
	(0.0164)	(0.0116)	(0.00958)
year_sold=2009	0.150***	0.180***	0.168***
	(0.0172)	(0.0111)	(0.00945)
year_sold=2010	0.263***	0.266***	0.263***
	(0.0165)	(0.0111)	(0.00929)
year_sold=2011	0.288***	0.298***	0.294***
	(0.0179)	(0.0112)	(0.00963)
year_sold=2012	0.331***	0.319***	0.320***
	(0.0177)	(0.0113)	(0.00963)
year_sold=2013	0.407***	0.345***	0.361***
	(0.0192)	(0.0123)	(0.0105)
year_sold=2014	0.414***	0.356***	0.370***
	(0.0195)	(0.0123)	(0.0105)
year_sold=2015	0.399***	0.338***	0.358***
	(0.0188)	(0.0127)	(0.0106)
year_sold=2016	0.429***	0.337***	0.360***
	(0.0210)	(0.0127)	(0.0110)
year_sold=2017	0.445***	0.391***	0.406***
	(0.0204)	(0.0125)	(0.0108)
year_sold=2018	0.470***	0.380***	0.407***
	(0.0201)	(0.0126)	(0.0108)
treated	-0.0914***	-0.00840	-0.0622***

	(0.0119)	(0.0117)	(0.00799)
treated*after	0.156***	0.0362**	0.108***
	(0.0140)	(0.0137)	(0.00944)
Constant	11.04***	10.96***	11.00***
	(0.0324)	(0.0189)	(0.0164)
Observations	1452	3330	4782
Adjusted R^2	0.799	0.779	0.778

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Notes: The DID estimation is estimated with a hedonic regression. All the dwelling characteristics shown in tables B.4 and B.5 in the appendix are used as controls. All the models are formed in a similar manner. In the column 1, prices of apartments within 400 meters from Myllypuro's shopping center are compared to the prices of apartment in the same distance band of the control groups shown in figure 5.

Table B.3: Desciptive statistics model 1: Myllypuro

	T 0 -400	T 400 - 800	C 800 -2000
Debt-free price	135721.79	130781.08	126367.19
Area	62.48	62.27	57.97
Rooms	2.59	2.53	2.41
Maintenance Charge	215.71	215.81	215.57
Floor number	3.77	3.17	3.33
Condition bad	0.05	0.07	0.06
Condition ok	0.45	0.47	0.45
Condition good	0.41	0.39	0.42
Condition excellent	0.00	0.00	0.00
Year built	1964.34	1965.99	1966.03
Year Sold	2010.29	2010.82	2010.76
Observations	668	535	3803

T = treatment group.

C = control group.

Table B.4: Desciptive statistics model 2: Control neighborhoods

	Treatment: 0 -800	Control 1: 0 - 800	Control 2: 0 - 800
Debt-free price	137191.45	127545.48	122111.40
Area	62.73	59.30	60.49
Rooms	2.58	2.40	2.44
Maintenance charge	219.13	218.73	222.43
Floor number	3.50	3.44	3.52
Condition bad	0.06	0.05	0.05
Condition ok	0.47	0.47	0.48
Condition good	0.41	0.42	0.41
Condition excellent	0.00	0.00	0.00
Year Built	1965.11	1968.08	1968.89
Year sold	2011.10	2011.39	2011.43
Observations	1038	3946	2788

Control 1: Kontula, Vuosaari, Itäkeskus, Mellunmäki.
Control 2: Kontula, Mellunmäki.

Table B.5: Desciptive statistics model 2: Alternative distance bands for control neighrbohoods

	T 0 -400	C 0 - 400	T 400 - 800	C 400 - 800
Debt-free price	139710.68	131460.66	134087.10	126328.01
Area	62.90	59.93	62.53	59.10
Rooms	2.61	2.45	2.55	2.39
Maintenance charge	218.39	216.01	220.05	219.58
Floor number	3.77	3.74	3.17	3.35
Condition bad	0.05	0.05	0.07	0.05
Condition ok	0.46	0.47	0.48	0.47
Condition good	0.42	0.43	0.39	0.42
Condition excellent	0.00	0.00	0.00	0.00
Year built	1964.35	1968.23	1966.05	1968.04
Year sold	2010.88	2011.39	2011.37	2011.39
Observations	573	936	465	3010

T = treatment group.

C = control group.